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Shasta Agness Landscape Restoration Project

LSR Consistency Review

Gold Beach and Wild Rivers Ranger Districts, Rogue River – Siskiyou National Forest, Curry and Coos Counties, OR

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Shasta Agness, Stand #03, Oregon white oak savannah

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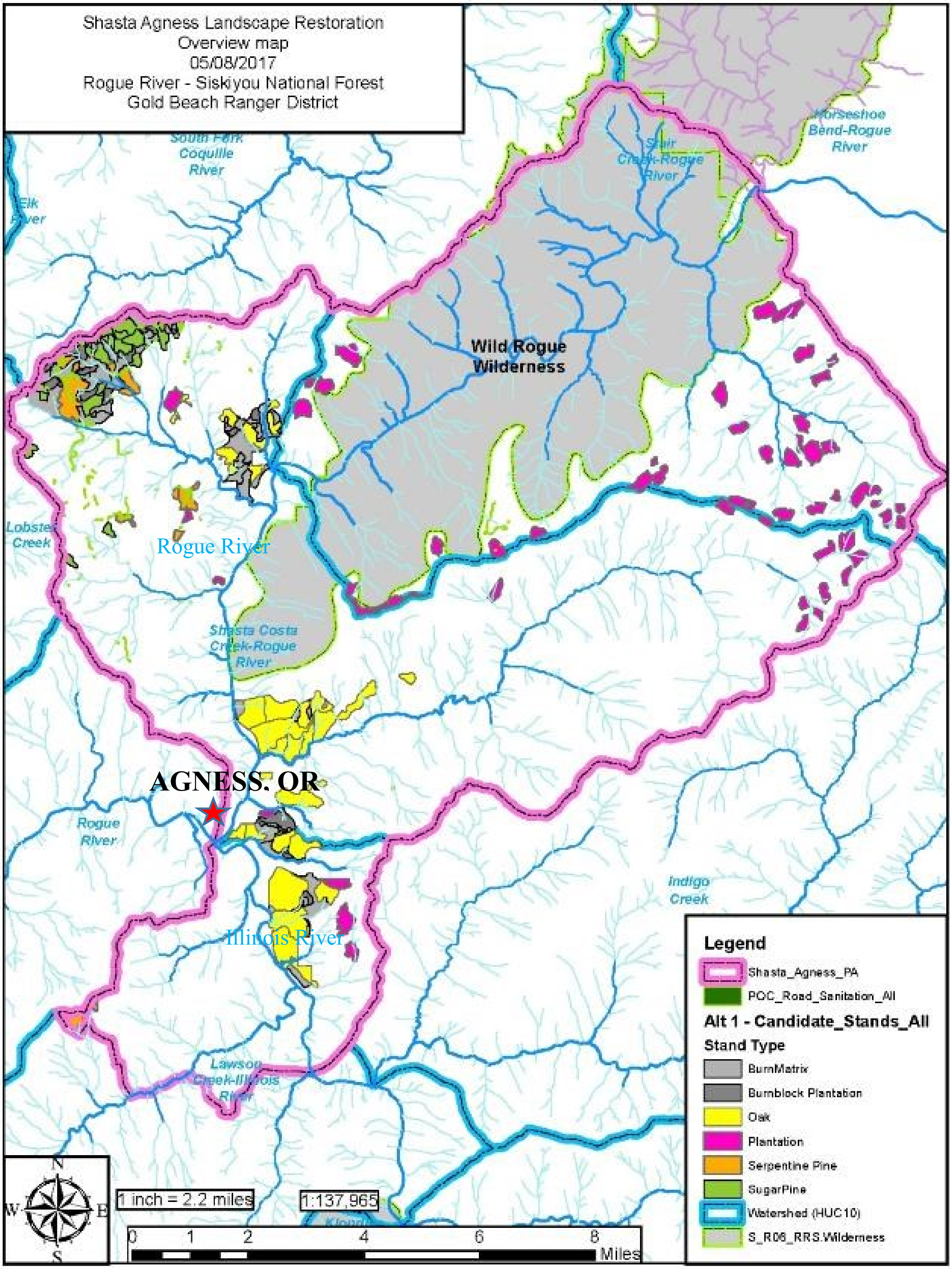

Introduction

The overall purpose of the proposed actions in the Shasta Agness project area is to restore resilience and ecological integrity to unique ecosystems, to accelerate the development of late-successional forests while preserving species diversity, to restore aquatic and riparian habitat, and to provide a diverse range of high-quality, sustainable recreation opportunities supported by an environmentally sustainable road system. This Late-Successional-Reserve (LSR) consistency evaluation document focuses on elements of the proposed actions where silviculture treatments that are not currently exempted from review would take place in LSR *(NWFP ROD – Standards and Guidelines and REO memos 694 and 801, dated July 9, 1996 and September 30, 1996, respectively).* These actions not currently exempted would require a letter of concurrence from the LSR workgroup in order to move forward. Some of the proposed activities are exempted by the 1995 Southwest Oregon LSR Assessment (USDA Forest Service and USDI Bureau of Land Management 1995). These activities would be mentioned and reference LSR assessment exemption. There are three main silviculture actions proposed in LSR that need to be addressed by the LSR workgroup or the Regional Executives.

1. Treatments in stands and cutting trees over 80 years old
2. Cutting trees over 20 inches diameter and up to 28 inches
3. Creating openings up to 2 acres in size in pine stands and up to ¾ acre in size in plantations.

Project summary and consistency with the NWFP

Shasta Agness is an integrated restoration project, focusing on several different vegetation communities that are currently on successional trajectories that would result in losing important structures, diversity, and habitat types within this late-successional reserve.

The purpose of the project is to restore unique habitats and species diversity important to late-successional conditions on the landscape, promote development of diverse late-seral forests, promote resilience within the landscape, and reintroduce natural processes to improve ecological integrity of these ecosystems. Proposed management activities include: unique habitat restoration by removing encroaching trees to restore oak savannahs and woodlands, sugar pine and serpentine forest stands; accelerating development of late seral forest structures, including riparian areas; improving landscape resilience to exotic pathogens; and applying controlled fires across larger areas of the landscape to achieve and maintain the desired conditions.

There are several categories of different stand types and/or target species that this project is addressing to meet the purpose and need. These include:

- **Oak savannahs and oak woodlands -** white or black oak present, mix of savannah and mixed hardwood/conifer woodlands
- **Sugar pine stands** - natural, mid-seral, closed canopy stands with sugar pine present
- **Serpentine influenced stands** - with Jeffrey pine, sugar pine, and endemic species
- **Plantations** - previous clearcuts, planted primarily with Douglas-fir
- **Port-Orford-cedar** - sanitation treatments (for exotic pathogen) only along open roadways
- **Prescribed fire and burn blocks** – larger areas identified for prescribed fire

This project would require consistency determination from the LSR workgroup for actions that would not fall under current exemptions for treatment. The project also proposes a project-specific plan amendment to the *NWFP* standard prohibiting harvest in stands over 80 years old (C-12) for treatments in LSR. This is because these treatments are considered necessary to restore ecological processes to these stands in order to promote late-successional forests that are diverse and structurally complex. Douglas-fir/tanoak forests dominant the forest cover across this planning area and within the larger southwest Oregon LSR. This project focuses on the restoration of uncommon, diverse forest types that are equally important to maintain on this landscape because they provide landscape scale heterogeneity, which leads to greater resilience and biodiversity.

Measures would be taken to promote both unique habitats and late successional forest attributes. Measures like retaining the largest trees, maintaining current suitable habitat, leaving skips for dead wood recruitment, and promoting diverse species composition and structure are some of the reasons why this project is consistent with LSR objectives.

Certain components of Shasta Agness require review by the LSR workgroup while another component requires a project specific plan amendment to the NWFP. This section briefly outlines the specific treatment elements of the proposed actions and whether such actions need a letter of concurrence (LSR Workgroup), a project specific plan amendment (Regional Executives), or are exempted activities that need no review. Table 1 outlines the proposed activities, components of these activities, and how they are consistent or not consistent with the NWFP.

Document outline –

1. Consistency with the NWFP – Table 1 summary
2. Why treat in LSR?
3. NWFP, Late-successional Reserve Assessment, and management plan
4. Landscape Context
5. General prescriptions and consistency - stand development, composition, structure, desired future conditions, general prescriptions, and more detailed justification on the need.
6. T&E species habitat
7. Dead wood
8. Appendix – more detail and supporting information

Due to the number of silviculture actions proposed that require review, this letter (pages 1-23) covers the actions and how they are consistent in an abbreviated version. Follow the hyperlinks throughout the letter to get to more detailed information about the stands, prescription, FVS outputs, figures and tables, and supporting science. Throughout this letter hyperlinks will link to Appendix – Consistency Review In-Depth.

Throughout the document, actions will be codified to indicate the level of review required for each action. Look for the following abbreviations next to sections.

- (**RE**) - regional executive review required for project specific plan amendment
- (**LSR-WG**) – Late-successional-reserve work group review and letter of concurrence
- (**EX**) – Exempt, action is exempted by LSR Assessment or other exemption criteria in the NFWP.

Table 1 - Proposed activities and consistency with NWFP

Treatment Type	Alternative 1 acres		Proposed activities	Consistent with RRS LRMP and NWFP?	Level of Review
Common treatments	Overlaps other treatment areas		Cut trees less than 20", less than 80 years, Rx fire, plant trees, remove non-natives, others	LSR Assessment (pg. 62, 66, 67), 1996 REO Silv Exemption Criteria	**EX** - None
Oak restoration	2199				
Oak savannah restoration		639	Cut trees 20-28" DBH	LSR Assessment (pg. 69), Unique Habitat Restoration	**EX** - None
			Cut trees 80-140 years old	LSR Assessment (pg. 69), Unique Habitat Restoration, Project specific plan amendment needed	Regional Executives
			Restore open meadows and oak savannahs	LSR Assessment (pg. 69), Unique Habitat Restoration	**EX** - None
Oak woodland restoration		1560	Cut trees 20-28" DBH	NWFP ROD C-17 - Habitat Improvement, LSR Assessment (pg. 66), Thinning	LSR Workgroup
			Cut trees 80-140 years old	NWFP ROD C-17 - Habitat Improvement, No - Project specific plan amendment needed	Regional Executives
Sugar pine restoration	549	549	Cut trees 20-26" DBH	NWFP ROD C-12, LSR Assessment (pg. 66), Thinning	LSR Workgroup
		53	Cut trees 80-100 years old	No - Project specific plan amendment needed	Regional Executives
		43	Create gaps up to 3/4 acre	LSR Assessment (pg. 66), Thinning	LSR Workgroup
		20	Create gaps up to 2 acre (only in current non-habitat for NSO)	LSR Assessment (pg. 66), Thinning	LSR Workgroup
Serpentine pine restoration	484	130	Cut trees 20-25" DBH	NWFP ROD C-12, LSR Assessment (pg. 66), Thinning	LSR Workgroup
		484	Cut trees 80-120 years old	No - Project specific plan amendment needed	Regional Executives
		48	Restore previously open serpentine meadows	LSR Assessment (pg. 69), Unique Habitat Restoration	**EX** - None
Port-Orford-cedar sanitation	241	241	Cut trees > 80 years old along open roads	LSR Assessment (pg. 69), POC *Phytophthora* Control, Risk Reduction (NWFP-ROD C-12 and C-13)	LSR Workgroup
Plantations	1635	1635	Variable density thinning	NWFP ROD C-12, LSR Assessment (pg. 66, 67) 1996 REO Silv Exemption Criteria	**EX** - None

Table 1 - Proposed activities and consistency with NWFP					
Treatment Type	**Alternative 1 acres**		**Proposed activities**	**Consistent with RRS LRMP and NWFP?**	**Level of Review**
		81 *(5%)*	Gaps up to 3/4 acre	NWFP ROD C-12, LSR Assessment (pg. 66, 67)	LSR Workgroup
Burn blocks	4545	1859	Rx fire – within and between silviculture treatment stands	LSR Assessment (pg. 62)	**EX** - None
Total acres	**6967**				

Why treat in LSR?

As previously noted, the common purpose of these vegetation treatments is to restore resilience and ecological integrity to unique ecosystems, and to promote critical components of late-successional forests while conserving species diversity.

Oak stands - Oak woodlands have suffered substantial losses in area and ecological integrity due to fire suppression and the resulting invading conifers. Composition, structure, and important habitat types associated with oak vegetation communities are transitioning to a closed canopy Douglas-fir forest. The oak savannah restoration treatments are consistent with LSR objectives because they are exempted in the LSRA, due to recognition that these open, unique habitat types are important for species and structural diversity, mast production, prey forage, and they compose a small proportion of the landscape.

Sugar pine stands– These mid-seral, closed canopy stands are developing in conditions that are and will result in reduction of sugar pine composition. Sugar pine composition on this landscape continues to decline due to white pine blister rust and suppression of fire which leads to lack of regeneration opportunities and dense stand conditions that leads to competition related mortality. This proposed treatment is consistent with LSR objectives because the prescription would leave the largest trees and promote species diversity, variable and complex stand structures, and mast (sugar pine nuts) production for prey species of NSO.

Serpentine pine stands – Serpentine savannah and the associated pine stands' structure and density has changed dramatically in the absence of fire on the landscape. Late-open forest structures have been replaced by closed canopy forests or have very dense mid-story canopies. Open stand conditions are important in serpentine areas to promote a diverse herbaceous and grassy understory, diverse tree species (including Jeffrey pine, sugar pine, and western white pine), and resilient forests. These treatments are consistent with LSR objectives this prescription restores a natural late-open forest structure that maintains species diversity, does not affect future suitable NSO habitat (non-capable sites), and these stand types provide structural and compositional heterogeneity across the landscape.

Plantations - These clearcuts were mostly planted with Douglas-fir and previously managed for timber production, resulting in the current homogenous, high density stand conditions with little species diversity. These treatments are consistent with LSR objectives, because they would promote resilient stands that are less susceptible to natural disturbances, and promote stand conditions to accelerate and improve development of late successional conditions.

Port-Orford-cedar (POC) sanitation - The objective is to reduce the risk of spreading Port-Orford-cedar root disease to uninfected stands where POC plays an important role to late-successional stand structure. POC is an important late-successional and riparian associated species that is highly susceptible to an exotic root disease pathogen (*Phytophthora lateralis*) that results in mortality. Therefore, continued spread of this disease threatens the role of POC in development of late successional stand structure. Open roads and the presence of the host species (POC) continue to act as vectors that spread the pathogen to uninfected POC in the planning area. Known POC stands exist on 4700 acres with at least 840 infected acres within the project area. Within the planning area, approximately 3500 acres of the 4700 acres of POC have some connection to a currently open road. These proposed actions are consistent with LSR objectives because they would reduce the risk of continued spread of the pathogen, which causes mortality to this important late-seral species within this LSR, and these actions are addressed in the LSRA.

Burn blocks and burn-between areas (prescribed fire) –The burn between areas are areas where prescribed fire is proposed in-between stands where overstory silviculture treatments are proposed. The historical fire regime has been greatly altered by fire suppression. Therefore, stands have experienced loss of beneficial effects provided by this natural disturbance process. Dense understories and ladder fuels have developed that leave the stands susceptible to stand replacement fires. Mature and late-successional forests are currently at risk of loss due to fire. Many of the plant communities in this project depended on fire for maintenance, and some plants are fire dependent and rely on heat from fires for to carry out their lifecycle. Prescribed fire is consistent with LSR objectives because it was identified in the LSRA as an important disturbance mechanism on the landscape for reducing risk of losing late-successional forests, maintaining forest structures and species that relied on fire, and promoting heterogeneous vegetation patterns and diverse species composition.

NWFP and Land Management Direction

The following sections will outline specific management direction, objectives, and guidelines that are specific to vegetation treatments in LSR.

The Siskiyou National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service 1989), was amended by the Northwest Forest Plan (NWFP) (USDA Forest Service and USDI Bureau of Land Management 1994). The majority of the proposed stands are located within LSR, as shown in Table 2.

It is important to note that Special Wildlife Sites (MA-9) are entirely overlaid by LSR and Supplemental Resource management area. Special Wildlife Sites are habitat or botanical sites which are important components of overall wildlife habitat diversity and botanical values (USDA Forest Service 1989) (IV-113). These areas and habitat types are addressed by the Southwest Oregon Late – Successional Reserve Assessment (LRSA) (USDA Forest Service and USDI Bureau of Land Management 1995) as areas exempted for certain treatments.

The Southwest Oregon Late – Successional Reserve Assessment (LRSA) objective is to assess how well the western portion of southwest Oregon LSR network is functioning (approximately 720,000 acres). Although each LSR is designed to include as much late seral forest as possible, it should also provide for landscape scale connections and ecosystem analyses at the watershed scale to provide specific information on provincial pathways, patterns, structure, and disturbance dynamics (including associated risks) (USDA Forest Service and USDI Bureau of Land Management 1995) (pg. 9). In this assessment, the LSRA refers to areas called "Unique Habitats", many of which were identified as Special Wildlife Sites by the Siskiyou National

Forest plan. The assessment also refers specifically white and black oak savannahs as unique habitats that were not mapped as Special Wildlife Sites (pg. 38). The LSRA estimates that as much as 2000 acres of oak savannah may have been missed in special wildlife site mapping. It specifically mentions oak savannah complexes on south-facing slopes of Shasta Costa Creek, Fall Creek, and areas around Big Bend and Oak Flat (pg. 39). These are the center of the focus for all of the oak restoration areas in this project. Serpentine pine savannahs are also mentioned as unique habitats in the LSRA (pg. 39), but are not described in detail.

Table 2. Proposed vegetation treatments within LSR

Land Use Allocation (LUA)	Stand Type	Total Acres
Late Successional Reserve (LSR)	Burn block Plantation	331
	Burn between	1394
	Oak	1656
	Plantation	1604
	Serpentine pine	484
	Sugar pine	547
	POC sanitation	240
Late Successional Reserve Total		**6257**

[1]Stand Type – Definitions and general prescription can be found below.

The LSRA identifies several silviculture activities that are exempt within this LSR. It generally lists that exempt projects consist of: prescribed fire, large woody material and snag recruitment, silvicultural treatments for development of late-successional characteristics, *Phytophthora* control (POC), unique habitat restorations, wildfire, maintenance of lookout seeing corridors and other non-silvicultural activities (pg. 62). Many elements of this proposed action are specifically mentioned in the LSRA (See Table 1, column titled "Consistent with RRS LRMP and NWFP?" for reference). More detail on specifics from the LSRA and exemptions can be found in Appendix – Exemption criteria - LSRA.

Landscape context

The majority (96%) of the approximately 93,000-acre planning area is in federal ownership, and nearly all of this area is designated for conservation of late-successional forests or preservation (Wilderness) (see Table 8 in Appendix). Much of this landscape has remained unmanaged (minus fire suppression) in the last 100 years. About 7,700 acres of 87,996 acres (9%) of Forest Service ownership has been clearcut starting in the early 1960s. This results in a fairly "in-tact" landscape with the majority of the late successional forests remaining. Currently analysis of the watershed using GNN data, classifies about 53 percent (48,444 acres) of the planning area is in late-successional forest condition (size class ≥ 21" DBH and canopy cover ≥ 40 percent) (Table 3).

As stated in the LSRA, treatments to restore these important vegetation communities are a small fraction of the larger LSR area. Promoting open habitat types (oak, serpentine savannahs, and gaps) in this project will affect 0.6% of the Fishhook LSR and 0.1% of the overall Southwest Oregon LSR. This threshold is well below the 2% that the LSRA identified for this habitat type. The majority of the treatment areas (6009 acres) will promote late-successional characteristics in 4% of the Fishhook LSR and 1% of the Southwest Oregon LSR. Late-successional components like species diversity, large trees, and multiple canopy layers would be promoted through these restoration treatments, but this would result in less down wood and snags over time (see Figure 28, 29, and 30 in Appendix). When considering the scale of these treatments in relation to the larger LSR, these actions are expected to have a negligible effect on the LSR and late-successional species.

Table 3. Late-successional forest by 5th-field watershed in the planning area

5th-Field Watershed Within Planning Area	Acres Late-successional (%)	Acres Federal[1] (%)	Total Acres All Ownerships
Lawson Creek – Illinois River (partial)	4,135 (39%)	9,308 (87%)	10,638
Shasta Costa Creek – Rogue River	23,789 (53%)	43,650 (97%)	45,026
Stair Creek – Rogue River	20,521 (56%)	35,9331 (98%)	36,544
Total Planning Area	**48,444 (53%)**	**88,891 (96%)**	**92,207**

Table 4. Larger LSR Context

Larger LSR Context	Total Acres	% of Area with Potential[(3)]	Acres - Current Late Successional	% - Current Late Successional	Alt 1 Treatment - % of LSR	Alt 1 - % Maintain or promote - LSR [(1)]	Alt 1 - % Emphasize unique habitats [(2)]
Fishhook LSR	151,965	91%	59,503	39%	4.6%	4.0%	0.6%
Southwest Oregon LSR	719,593	81%	289,444	40%	1.0%	1.0%	0.1%

Fishhook LSR is the largest of 10 LSR blocks within the larger Southwest Oregon LSR analyzed in the LSRA. LSR acres from Table 1 in LSR Assessment update 2004 (including update from Biscuit fire acres). [(1)] Alternative 1 treatments (6009 acres) designed to promote/maintain late successional forest conditions. [(2)] Alternative 1 treatments (958 acres) designed to maintain or restore open savannah conditions. [(3)] Area that have potential to produce older forest conditions.

General prescriptions and consistency

The project has proposed several different prescriptions, many of which are exempted silviculture activities in LSR. These exempted activities will be briefly mentioned, but focus will be given to proposed silviculture activities that require LSR workgroup and regional executives review.

Oak stands

The oak stands have highly variable conditions in composition and structure, ranging from open oak savannahs to closed canopy mixed hardwood/conifer stands. Oak savannahs are very open forest types with scattered white oak and black oak that have been encroached by Douglas-fir. Oak woodlands consist of mixed hardwood/conifer, closed-canopy stands with more black oak than white oak and generally have a dense overstory of Douglas-fir (see Appendix for current conditions).

Oak savannahs

The oak savannahs are an open habitat type of savannah and oak forests that have been encroached by Douglas-fir (see Appendix for stand development). The current conditions are highly variable, and range from open oak savannah to oak savannahs that have been severely encroached and overtopped by Douglas-fir cohorts that ranges from 56-140 years old (see

Appendix for current conditions). These oak savannah areas occur due to a combination of abiotic site factors and disturbance history. The soils on these sites droughty and shallow, resulting in a poor environment for growing large conifers (see Abiotic conditions in Appendix).

LSRA & NWFP - The LSRA addresses exempted silviculture prescriptions for oak restoration (USDA Forest Service and USDI Bureau of Land Management 1995) (pg. 69). The desired future conditions for oak stands is not late-successional forests as defined by the NWFP; however, oak savannahs are recognized in the LSRA as a unique habitat type that should be maintained on the landscape. The LSRA defines exemption criteria for prescriptions that are designed to remove encroaching vegetation from oak savannahs. These oak savannah treatments are consistent with LSR objectives because they are exempted in the LSRA, due to recognition that open, unique habitat types are important for species and structural diversity, mast production, prey forage, and they compose a small proportion of the landscape. (See Appendix for exemption criteria)

Desired Future Condition - The desired future condition of the oak savannahs is a mostly open savannah with Oregon white oak, some canyon live oak, scattered ponderosa pine, and California black oak around the edges of openings. The understory vegetation would be dominated by grasses and forbs. Frequent treatments of prescribed fire would maintain this open savannah forest structure and promote the desired species composition. Establishment of oak regeneration is important, especially in areas where conifer overtopping has resulted in oak mortality. (See Appendix for desired future conditions)

Prescription – *639 acres* -Intensive overstory removal treatments are proposed within oak savannahs including: expanding oak savannah openings, radial release around white oak, black oak and ponderosa pine, skips, prescribed fire, and planting. Treatments would utilize commercial logging techniques, handsaw work, and prescribed fire. Treatment would cut trees up to 26” DBH in thinning areas and up to 28” when releasing oaks. Prescriptions would remove NSO dispersal habitat in some areas. All treatment components are exempted under the LSRA except cutting trees greater than 80 years old. (See Appendix for detailed prescription)

Why cut trees >80 years old? – *639 acres* - (LSR-WG) –Nearly all of the Douglas-fir that are encroaching the savannahs and overtopping oaks along savannah edges are greater than 80 years old. Cutting trees greater than 80 years old is consistent with LSR objectives because, effective treatments to restore an open oak savannah is not possible without cutting and removing these trees. This would fail to restore an important unique habitat type emphasized and exempted in the LSRA. Further, most of these savannahs do not support NRF or dispersal habitat, and they would not be able to achieve this condition into the future. This proposal would remove 200 acres of NSO dispersal habitat, no NRF habitat, no CH for MAMU, and is expected to improve mast production, which would improve forage for important prey species for old growth-dependent species. Tanoak is the primary mast producer in this landscape. With continued spread of Sudden Oak Death (SOD) (*Phytophthora ramorum)* in adjacent watersheds and loss of tanoak, promoting resistant species like Oregon white oak is an important strategy to maintain mast producing species in this landscape. (More supporting rationale)

Post Treatment - White oak savannahs would have very few (0-10 TPA), large Douglas-fir remaining. Large Douglas-fir snags would exist around edges, especially within riparian area’s and closer to streams. Oaks would have open grown conditions with little to no shading from Douglas-fir. Herbaceous forbs and grassy vegetation would be the dominant ground cover vegetation. Fuels conditions would be suitable for frequent prescribed fire, maintaining this oak savannah condition. (See Appendix post treatment conditions)

Oak woodlands

These oak woodland areas are currently closed canopy forests, with a white or black oak component. These stands are variable, but consist of single cohort of overstory Douglas-fir that range from 56-140 years old with a few scattered remnant trees in some stands. Some small pockets still have a black and white oak that constitute the primary canopy cover (see Appendix for current conditions).

LSRA & NWFP - These areas/conditions are not explicitly covered as exempted for silviculture activities in the LSRA. Observations indicate that many of the sites were once open oak woodlands, and the LSRA does indicate that some black and white oak savannah areas were missed because slowly invading conifers obscured the true origins of the sites (USDA Forest Service and USDI Bureau of Land Management 1995) (pg. 39) (see Appendix for Stand Development). Silviculture exemptions for thinning were listed in the LSRA and are being proposed in oak woodlands (LSRA pg. 65). These include exemptions for thinning in high density, even-aged, single layered stands to develop old growth, reduce risk of large-scale disturbances, reduce uniformity, and favor minor species, including hardwoods (See Appendix for exemption criteria). This would also be considered a habitat improvement project (C-17) under the NWFP, by promoting improved foraging habitat for NSO and promoting development of diverse and structurally complex late-successional forests with improved mast production.

Desired Future Conditions - The desired future conditions of the oak woodland areas would be a mixed conifer-hardwood forests with large trees, species diversity and structural complexity. Large Douglas-fir trees would be intermixed within California black oak, scattered Oregon white oaks, ponderosa pine, and grass and forbs in the understory. Oaks would be released, and new oak seedlings would regenerate and become a much larger component of the stand composition. Oak mast production would increase, creating improved foraging habitat for deer, elk, bears, many bird species, and woodrats. This improved mast production would improve foraging habitat for NSO, by increasing an important food source for prey species such as the woodrat. Frequent treatments of prescribed fire would maintain this late open forest structure and promote the desired species composition. (See Appendix for more on desired future conditions)

Prescription – *1560 acres* - Variable density treatments are proposed within oak stands including: expanding oak savannah openings, radial release around white oak, black oak and ponderosa pine, thinning to reduce stand density, skips, prescribed fire and planting. Treatments would utilize commercial logging techniques, handsaw work, and prescribed fire. Cut trees up to 26" DBH in thinning areas and up to 28" when releasing oaks. Cutting intensity would be highly variable depending on composition of oaks and current NSO habitat. Prescriptions would remove NSO dispersal habitat (226 acres) in some areas with high oak composition. Most NSO habitat in this forest type would be treat and maintain. All treatment components are exempted under the LSRA except cutting trees greater than 80 years old. (See Appendix for detailed prescription)

Cutting trees >20 inches DBH - *1560 acres* - (LSR-WG) - A critical component of the silvicultural prescription is to release white and black oak from competition from Douglas-fir. Due to the size of the conifers overtopping oaks, it is necessary to remove trees up to 28" DBH. Giving prescription flexibility to cut trees larger than 20" is essential to achieve some full release of oaks. A ten year study of Oregon white oak release found that response of oaks to half-release treatments were small, the growth response was not significant, and it is unclear for how long the acorn production will persist (Devine and Harrington 2013). This is consistent with LSR objectives because the prescription would leave the largest trees in the stands and promote species diversity, and complex stand structure. This proposal would remove 226 acres of NSO dispersal habitat, no NRF habitat, no CH for MAMU, and is expected to improve mast production, which would improve forage for important prey species for old growth-dependent species. (See appendix for more details)

Cutting trees >80 years old - *1560 acres* - (RE) – Nearly all of the Douglas-fir that are topping the oaks are greater than 80 years old. Without cutting these trees to provide more sunlight to oaks and understory vegetation, shade intolerant oaks will continue to succumb to competition from the dense overstory of conifers. Treatments would restore these important forest types on the landscape, creating heterogeneous patterns of late-seral forest structures and species diversity. With continued spread of Sudden Oak Death (SOD) in adjacent watersheds and loss of tanoak, promoting resistant species like Oregon white oak is an important strategy to maintain mast producing species in this landscape. Cutting trees greater than 80 years old is consistent with LSR objectives because the prescription would leave the largest trees and promote species diversity, complex structure, and mast production for prey species of NSO. (See appendix for more details)

Owls forage within oak savannahs (in winter in lower elevations) and in manzanita shrub-fields in southern Oregon and northern California with low basal areas of conifer trees, presumably because they contain dusky-footed woodrats (Irwin and others 2012). Both conifer and hardwood mast appear to be a critical food for some owl prey species and "likely has a strong bottom-up trophic effect" [p. 6] (Dan L. Hansen and Dunk 2016). The authors further suggest opening the canopy and using fire to restore oak to benefit these species. This suggests proposed oak restoration treatments, would improve conditions for owls and their prey in multiple indirect ways. A diversity of tree species was also described as important to provide asynchronous mast production, thus providing continuity in food supply to prey species, so the value of restoring and preserving both oak and pine stands would go beyond just the amount of available of food, but also when it was available. Late-successional forests and NRF are not in shortage in this planning area (53%), so opportunities to develop quality foraging habitat and heterogeneity would benefit this LSR.

Post Treatment - Oak woodlands would have much few Douglas-fir but still retain 15-50 Douglas-fir per acre. Black oak and white oak would have 30-50 feet of clearing around these trees, with some larger Douglas-fir remaining adjacent to oaks (26-45"). The Douglas-fir overstory would generally be much more open with a mixed hardwood stand in the midstory. Residual Douglas-fir would be very clumpy, with very open areas around oaks and clumps of Douglas-fir where there are less oaks. Scattered ponderosa pine would have 30-50 foot clearing around these trees. Some areas where no oaks are currently present would have an open canopy Douglas-fir overstory, with planted black and white oak, mixed hardwoods, and an herbaceous ground cover. Skips would be focused on areas without oaks, within riparian reserves, in NSO NRF habitat, and in areas currently developing towards a late-seral condition. Snags would be present throughout treatment units, but focused within riparian areas, where felling would damage oaks, and in skips. (See Appendix post treatment conditions)

Sugar pine stands

These stands are naturally regenerated stands that established after fires from 1900-1930s. The even-aged, closed canopy stands are currently composed of sugar pine, Douglas-fir, giant chinquapin, and tanoak. Current stand structure in many stands lacks structural complexity and has high stand densities, resulting in decreased vigor of sugar pines and mortality (see Appendix for current conditions)

LSRA & NWFP - For stands that are less than 80 years old (496 acres), thinning treatments to promote late-successional conditions are permitted under the NWFP (USDA Forest Service and USDI Bureau of Land Management 1994) (C-12). Silviculture exemptions for thinning were listed in the LSRA that are being proposed in sugar pine stands (LSRA pg. 65). These include exemptions for thinning in high density, even-aged, single layered stands to develop old growth, reduce risk of large-scale disturbances, promote diversity, grow large trees faster, release of minor species, and planting of disease resistant sugar pine. The LSRA also specifically mentions the issue of sugar pine mortality (LSRA pg. 45). (See Appendix for exemption criteria)

Desired Future Conditions - The desired future condition of sugar pine stands would be a late-open forest structure, with large sugar pine, Douglas-fir, and hardwoods. Large sugar pines would continue to have adequate space to grow, relatively free from Douglas-fir competition. Patches of open areas would allow for recruitment of rust-resistant sugar pine and western white pine stock (planted) to mature and reproduce, creating the next generation of 5 needle pines with genetic resistance to the exotic disease. This forest would look like and function as late-successional forest, but with lower canopy covers and a more diverse mix of flora species that would be better represented under natural fire regimes. (See Appendix for more on desired future conditions)

Prescription – *549 acres* - Variable density treatments are proposed within sugar pine stands including: radial release around sugar pine and western white pine, thinning to reduce stand density, and creation of gaps, skips, and prescribed fire. This proposes stand density reduction with radial release cutting of most conifers and hardwoods within 35-60 feet of pines suitable for release from competing trees. The treatment would cut trees up to 24" DBH in thinning areas and up to 26" when releasing pines. Target canopy covers range from 20-40% in mixed pine forests that currently have low overstory canopy cover, to 40-60% in mixed pine stands that are currently closed canopy. Intentionally created openings ("gaps") of ¼ to 2 acres would be strategically placed throughout stands to promote early seral species and disease resistant pine regeneration and recruitment. (See Appendix for detailed prescription)

Cutting trees >20 inches DBH - *549 acres* - (LSR-WG) - Prescribing for cutting trees up to 26" DBH allows for effective release around most sugar pines and western white pines. A 9-year study in Southwest Oregon (Goheen 2011) found that full release treatments with reserves (leave all trees >25" DBH) around sugar pine increased growth, decreased tree mortality, and increased sugar pine regeneration better than no treatment, partial release, and full release. In thinning areas, cutting up to 24" DBH allows more variable cutting patterns, leaving behind a clumpier stand with reduced stand density. Not cutting over 20" trees would result in a fairly uniform thin from below in some portions of stands with larger trees. This proposed treatment is consistent with LSR objectives because the prescription would leave the largest trees and promote species diversity, variable and complex stand structures, and mast (sugar pine nuts) production for prey species of NSO (See appendix for more details).

Cutting trees >80 years old - *53 acres* - (RE) - In the sugar pine stands not treating the overstory (which is 80-90 years old) would make the stand density reduction and pine release infeasible in these 53 acres. Without treatment, it is likely that natural succession would result in an extended stem-exclusion stage with continued low structural complexity, and the loss of sugar pine from these stands. This is consistent with LSR objectives because the prescription would leave the largest trees and promote species diversity, variable and complex stand structures, and mast (sugar pine nuts) production for prey species of NSO. No NSO habitat would be downgraded/removed in sugar pine stands. (See appendix for more details)

Why create gaps up to 2 acres? - 20 acres - (LSR-WG) - Two acre gaps, not exceeding 20 acres total across the 500 acres, are proposed for 2 primary purposes. The first purpose is to create open areas large enough to provide opportunities for successful regeneration of pines and recruitment into the overstory. A study on seedling tree height growth response following gap creation found that shading edge effect can be minimized when gaps are larger than 1.5 acres (York and others 2004). This would create areas where dozens of sugar pine trees (per gap) can reach reproductive maturity relatively quickly, creating seed banks of disease resistant genetics in the landscape. The second purpose of the larger gaps is to create a heterogeneous pattern across the landscape, with open areas for small patches of early seral species. These 2 acre gaps will be located in areas that are not currently on a trajectory of becoming Nesting Roosting Foraging (NRF) habitat for the northern spotted owl (NSO). This is consistent with LSR objectives because the prescription would leave the largest trees (>26" DBH), promote species diversity and mast (sugar pine nuts) production for prey species of NSO, and not effect current or future suitable habitat for NSO. (See appendix for more details).

Post Treatment - Sugar pine stands would have sugar pine that are growing in open canopy condition with little competition from competing conifers or hardwoods. The largest Douglas-fir would remain and be found in a variable and clumpy distribution. Gaps would be variable in size (¼ acre to 2 acres), and oriented on ridgelines and south aspects to receive maximum solar exposure. Stands will have 30-100 trees per acre (>7" DBH) and maintain 40% canopy cover average across the stand. Basal area will range between 100 and 140 ft2/acre. No NSO habitat will be downgraded/removed in sugar pine stands. (See Appendix for post treatment conditions)

Serpentine pine stands

All of these stands are located in soils that developed from ultramafic parent materials such as peridotite and serpentinite. Open forest structures have been replaced by closed canopy forests or have very dense mid-story canopies. Vegetation composition and structure are shifting due to the slow invasion and increased density of trees and shrubs. Observations suggest that many of these stands historically incurred frequent, low or mixed severity fires that maintained a late-open stand structure. Current structure consists of an older overstory cohort, possibly 200-400 years old, which developed in very low density, open canopy conditions. The formerly open space is now occupied by a cohort that is 120 years old or younger, with many smaller conifers, hardwoods, and brush. (See Appendix for stand development and current conditions). These soils are nutrient limited and have limited capacity to grow many tree species. Most of these areas are incapable of developing into suitable habitat for the spotted owl (see Abiotic conditions in Appendix).

LSRA & NWFP - Silviculture exemptions for thinning were listed in the LSRA that are being proposed in serpentine pine stands (LSRA pg. 65). These include exemptions for thinning to develop old growth, reduce risk of large-scale disturbances, promote diversity, limiting understory around pines and on south aspects, release of minor species, and planting of disease resistant sugar pine. It also specifically mentions the Jeffrey pine plant series, and the need to simulate the historic fire frequency in these areas (LSRA pg. 63). (See Appendix for exemption criteria)

Desired Future Conditions - The desired future condition of these serpentine areas would vary widely, just as the current vegetation patterns in these soils vary widely. The general trend would be lower forest densities across the serpentine restoration stands, resulting in higher flora species richness. Sugar pines, western white pine, and Jeffrey pine would be growing relatively free from competition of Douglas-fir, incense cedar, and hardwoods. Open areas would allow for recruitment of rust-resistant sugar pine and western white pine stock (planted) to mature and reproduce, creating the next generation of 5 needle pines with genetic resistance to the exotic disease. Since many of the common and rare serpentine associated species depend on open canopy conditions, keeping fire as the primary disturbance mechanism would be important. (See Appendix for more on desired future conditions)

Prescription – ***484 acres*** **-** Variable density treatments are proposed within sugar pine stands including: radial release around Jeffrey pine, sugar pine, and western white pine, thinning to reduce stand density, understory and midstory treatments, prescribed fire, and skips. This proposes stand density reduction, with radial release cutting of most conifers and hardwoods within 35-60 feet of pines suitable for release from competing trees. Cut trees up to 20" DBH in thinning areas and up to 26" when releasing pines. Target canopy covers ranges from 0-20% in serpentine pine savannahs, 20-40% in mixed pine forests that currently have low overstory canopy cover, and 40-60% in mixed pine stands that are currently closed canopy. Treatments within serpentine pine stands is mostly non-commercial, with 130 acres of commercial treatments proposed. (See Appendix for detailed prescription)

Cutting trees >20 inches DBH - ***130 acres*** - **(LSR-WG) -** Prescribing for cutting trees up to 26" DBH allows for effective release around most Jeffrey pine, sugar pines, and western white pines. A 9-year study in Southwest Oregon (Goheen, 2011) found that full release treatments with reserves (leave all trees >25" DBH) around sugar pine increased growth, decreased tree mortality, and increased sugar pine regeneration better than no treatment, partial release, and full release. This is consistent with LSR objectives this prescription restores a natural late-open forest structure that maintains species diversity, keeps the largest trees, and provides heterogeneity to the landscape. (See appendix for more details)

Cutting trees >80 years old - ***484 acres*** - **(RE) -** In the serpentine pine stands not treating the Douglas-fir and hardwood cohorts that are 80-112 years old would make the stand density reduction and pine release infeasible in many parts of these 484 acres. These stands are important late-successional stands that are slowly changing in species composition and structure. Protecting and sustaining the older cohort overstory through density management of the 80-120 year old cohort is an important strategy to maintain this unique late-successional forests. This is consistent with LSR objectives because the this prescription restores this late-open forest structure and maintains species diversity in stands that aren't capable of becoming high quality NSO habitat. (See appendix for more details)

Post Treatment - Serpentine pine stands would have large sugar pine, Jeffrey pine, and western white pine and other species growing in open canopy condition with little competition from competing conifers or hardwoods. The largest Douglas-fir would remain and be found in a variable and clumpy distribution. Open serpentine savannahs would be restored and serpentine meadows would be restored to previous extent. The stand canopy would be very open in some areas with canopy covers below 40% on average. Other areas may have canopy covers between 40% and 60%, but not generally higher than 60%. Stands will have 36-75 trees per acre (>7" DBH) and basal area will range between 60 and 140 ft2/acre. NSO dispersal habitat would be removed on 64 acres, all of which is considered incapable of becoming NRF habitat. (See Appendix post treatment conditions)

Plantation stands

In the project area, approximately 7700 acres of presumably old growth forests were removed through clearcutting from 1960 to 1997. The plantations this project is focusing on (1635 acres) are plantations that are not already covered by other NEPA decisions, and were harvested between

1960 and 1975. These stands were typically planted with timber production in mind, therefore these stands typically lack structural and species diversity and are growing in dense and homogenous conditions. This project would treat these plantations with variable density thinning treatments to promote development of a complex forest structure with large trees and species diversity.

LSRA & NWFP- All of the plantation stands are less than 80 years old, therefore thinning treatments to promote late-successional conditions are permitted under the NWFP (USDA Forest Service and USDI Bureau of Land Management 1994) (C-12). Silviculture exemptions for thinning were listed in the LSRA that are being proposed in plantations (LSRA pg. 65). These include exemptions for thinning in high density, even-aged, single layered stands to develop old growth, reduce risk of large-scale disturbances, promote diversity, grow large trees faster, release of minor species, and planting of disease resistant sugar pine. The LSRA also specifically mentions silviculture manipulation of young managed stands to accelerate the development of structural and compositional features of older forests (LSRA pg. 66). (See Appendix for exemption criteria)

Desired Future Conditions – These plantations would have a wide variety of different species compositions and structures, depending on the surrounding examples of unmanaged, late-successional forests in the area. In general these stands would develop large trees, complex and diverse canopy structures, canopy gaps, diverse species composition, and snags and down wood.

Prescription – ***1635 acres*** **-** Variable density treatments are proposed within plantations including: radial release shade intolerant minor species, thinning to reduce stand density, understory and midstory treatments, prescribed fire, tree planting, and skips. Trees over 20 inches DBH will only be removed if they are located in created opening, as specified in REO Memorandum #694 (pg. 6). Gap openings up to ¾ acres in size and not to exceeding 10% of the stand area are proposed.

Why create gaps up to 3/4 acres? - (LSR-WG) – This is consistent with LSR objectives because the NWFP states one of the roles of silviculture is to create canopy gaps that enable the establishment of multiple tree layers and diverse species composition (NWFP, B-5). 3/4 acre gaps are proposed for 3 primary purposes. The first purpose is to create open areas large enough to provide opportunities for successful regeneration of pines and recruitment into the overstory, while not removing too large of an areas that could become NRF habitat for the NSO. The second purpose is to produce large trees along edges of gap, creating a variable and complex stand structure that would develop into NRF for NSO. The third purpose of the larger gaps is to promote a heterogeneous pattern and diversity across the landscape, with open areas that promote biodiversity within the stand. (See Appendix for more on ¾ acre gaps)

Post Treatment – These plantations would have a wide variety of post treatment conditions within each stand. Skips, gaps, and thinned areas would provide good diversity of structure across the stand. Thinned areas would have 50-100 TPA of the largest trees with the best live crown ratios. The distribution of these trees would vary, with some clumping and some wide crown thinning. Minor species will remain. Gap openings would have an open overstory, potentially leaving some trees for development of large trees with complex crown structure. Skips would remain around riparian areas and around edges of stand to provide dense stand conditions, conducive to tree mortality and creation of dead wood. NSO dispersal habitat would be maintained.

Port-Orford-cedar roadside sanitation

Port-Orford-cedar (POC) is highly susceptible to an exotic root disease pathogen (*Phytophthora lateralis*) that results in mortality. This exotic disease has greatly reduced the number of large POC (especially in riparian areas) in the project area. Known POC stands exist on 4700 acres with at least 840 infected acres within the project area. Within the planning area, approximately 3500 acres of the 4700 acres of POC have some connection to a currently open road. Implementing the applicable POC management practices from the POC ROD (USDA Forest Service 2004) could reduce the risk of spreading the pathogen. Many of the POC management practices would be applied in the project, but only roadside POC sanitation needs to be addressed for consistency with the NWFP. (See Appendix for more)

LSRA & NWFP- POC sanitation treatments are exempted treatments in LSR because they reduced the risk of continued spread of an exotic pathogen that has negative effects on an endemic late-seral species and late-successional forest structure (See Appendix for exemption criteria). This treatment would reducing the risk of disturbance that adversely affects developing and current late-successional forests. This treatment would be applied across many different stand types and successional classes, including current late-successional forests. There are 3 criteria for risk reduction in older stands (NWFP, C-13), which include:

- (1) The proposed management activities will clearly result in greater assurance of long-term maintenance of habitat - *Within the planning area, approximately 3500 acres of the 4700 acres of POC have some connection to a currently open road, putting potentially 3500 acres of late-seral forests at risk. This treatment reduces the risk of continued loss of an important late-seral and important mid-story species that contributes to late-successional structural complexity.*
- (2) The activities are clearly needed to reduce risks - *The spread of the pathogen to uninfected POC populations continues within the planning area (see Figure 25). Roadside sanitation is one of the POC management practices recommended by the POC ROD (USDA Forest Service 2004) to reduce the risk of continued spread of the pathogen.*
- (3) The activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established - *Treatments would occur in 240 acres along open roadways, but could reduce risk on up to 3500 acres. Project design criteria for treatments do not allow for treatments that reduce canopy cover below thresholds for NSO and along streams. No POC would be removed from riparian areas and no POC larger than 20" DBH would be removed from LSR. The limited spatial scale and mitigations for large wood and canopy cover would maintain late-successional forest structure in these stands.*

The LSRA lists POC *Phytophthora* control as exempt activities in the LSR (pg. 69). The LSRA identifies that appropriate controls should be taken to control the disease and keep large POC trees from dying by utilizing site specific analysis options to lower the risk of infection. Options can include road management, sanitation, moisture conditions for operations, trees spacing, planting POC, and other appropriate measures (pg. 69). Many of the applicable POC management strategies identified in the POC ROD (USDA Forest Service 2004) would be applied. These actions are consistent with LSR objectives because they would reduce the risk of continued spread of the pathogen, which causes mortality to this important late-seral species within this LSR. (See Appendix for exemption criteria)

Desired Future Conditions – The desired future condition for Port-Orford-cedar (POC) on this landscape is to maintain existing live populations in low risk areas, to slow and reduce the risk of spreading the pathogen, and to establish disease resistant genetics in the landscape. POC would continue to contribute to late-successional structures through midstory development, ongoing regeneration of this shade-tolerant species, and providing large tree structures. POC would remain established and regenerate within riparian areas, providing an important source of shade and large wood in streams. Disease resistant POC stock would be planted on appropriate sites and would to mature and reproduce, creating the next generation of POC with genetic resistance to the exotic disease.

Prescription – *241 acres* – POC sanitation involves cutting of all live POC in the high risk zone, defined as 25 feet above open roads or to top of cut bank, 50 feet above below roads, and 100 feet below roads around stream crossings (USDA Forest Service and USDI Bureau of Land Management 2004). Sanitation treatments will not result in stand canopy cover being reduced below 50% in riparian reserves, below 60% in NSO nesting-roosting-foraging habitat, or below 40% in NSO dispersal habitat. Planting of disease resistant POC is proposed in appropriate sites for POC within the project area. Planting may occur in plantations, serpentine pine stands, and some sugar pine stands. Sanitation treatments would not cut, but not remove any POC from riparian areas (175 feet from streams). In upland areas treatments would cut trees larger than 20 inches DBH, but not remove any trees larger than 20 inches DBH. (See Appendix for detailed prescription)

Cutting trees >80 years old – *160-200 acres* - (LSR-WG) Cutting of trees older than 80 years old is proposed in POC sanitation. Sanitation treatments are most effective if all of the host species trees are removed (personal communication, Ellen Goheen - plant pathologist, 2016). Leaving trees due to their size or age is ineffective at creating a truly host-free zone. This action is consistent with LSR objectives because it reduces risk of adverse disturbance to a larger area of late-successional forest, prescription criteria are designed to maintain current NSO habitat, and large wood will be retained on site.

Post Treatment – Following treatment, no live POC would be left within the high risk zones along open roads. All trees boles would be left within riparian areas and POC down wood greater than 20" DBH would remain at all sites. Stand canopy cover would remain mostly unchanged. Some areas will have less mid-story canopy. POC regeneration is expected to continue along disturbed areas near roadways. Continued sanitation treatments will need to continue for this treatment to remain effective.

Prescribed fire and burn blocks

Shasta Agness proposes applying prescribed fire to restore an important natural disturbance mechanism to these forests. Larger prescribed fire areas are "burn blocks" to help achieve the restoration objectives and give better implementation flexibility when applying prescribed fire on the ground. There are five burn blocks that total 4,545 acres. These are essentially planning 5 fires on southern aspects where fire was more active on the landscape. These burn block would include mechanical treatment stands (2686 acres) where many candidate stands were grouped together and would include the in-between areas (1859 acres) to make for larger continuous areas to apply fire. These in-between areas are referred to as "Burn between" areas. These areas often contain the emphasis species this project is promoting, and these stands will benefit from reintroduction of fire in these burn blocks (See appendix for maps and more information). All stands are being analyzed for prescribed fire, although not all will likely receive the treatment. The total acreage potential for prescribed fire is 6726 acres (doesn't include POC sanitation areas).

LSRA & NWFP - The LSRA states that prescribed fire can reduce the risks of wildfire setting back the late-successional characteristics of the LSRs. In addition, it can produce elements such as canopy gaps, multistoried conditions, snags, and patchy understories needed for late-successional conditions (pg. 62). Prescribe fire on the Jeffrey pine plant series would simulate the historic fire frequency with which the plants evolved (pg. 63). Prescribe fire on wildlife sites, especially meadows and oak/pine savannas, would maintain their habitat characteristics (pg. 63). Burn intensity should result in retaining as many large trees as possible, by keeping high intensity fire behavior to less than 15% of the burn area (pg. 63). Prescribed fire is consistent with LSR objectives because it was identified in the LSRA as an important disturbance mechanism on the landscape for reducing risk of losing late-successional forests, maintaining forest structures and species that relied on fire, and promoting heterogeneous vegetation patterns and diverse species composition. (See Appendix for exemption criteria)

Desired Future Conditions – The desired future condition of these burn block areas will be highly variable from the open oak savannahs to the sugar pine stands on the ridgetops. The desired condition is a forest that could retain the majority of the overstory canopy cover in the event of wildfire. Reduced fuel loadings, tree densities and a lower representation of shade tolerant species would allow low severity fire to play a larger role in maintaining desired conditions. By allowing fire to resume a more frequent role, important components of late-successional forests such as complex stand structure, resilience to disturbance, large trees, and diverse species composition would all be maintained. These areas would be more resilient to wildfire, making the treated areas more likely to achieve and maintain late-successional conditions. In many of the vegetation types, especially the oak savannahs, the fuels and fuel structure would be in a condition where repeated prescribed fire treatments could be achieved with little to no mechanical treatments.

The large trees would be resilient to most potential wildfire conditions. Good species representation would remain, including pines, oaks, and herbaceous and shrub vegetation types that rely on fire and more open forest canopies. Tree and shrub density in the understory and midstory would be lower in many places, with other areas retaining high density patches or corridors.

Prescription – 6726 acres – Most candidate stands will receive mechanical density treatments as described for each stand type before application of prescribed fire. The burn-between areas (outside treatment stands, 1859 acres) may receive some mechanical treatments prior to prescribed fire in order to achieve desired fire effects (example – remove ladder fuels to prevent overstory torching). These pre-fire mechanical treatments would focus on trees and brush in the understory and midstory. Prescriptions would generally include cutting material less than 12" in diameter. Lop and scatter or hand-piling of fuels may be required in some areas to reduce fuels to appropriate levels to apply prescribed fire. Prescribed fire ignitions would be applied to achieve a surface fire, with occasional individual tree torching or group torching. Pines, oaks, and large trees would ideally survive these fires. Application of prescribed fire would attempt to achieve low severity fire effects to fire sensitive areas like inner gorges of riparian areas and current late-successional forest structures.

Post Treatment – Post-treatment conditions within prescribed burn areas would change the understory and midstory vegetation more than the overstory vegetation. Treatments would reduce surface fuels, brush composition, and reduce some midstory canopy and small trees. Overstory canopy would remain largely intact. Some single tree mortality or groups of overstory tree mortality is expected. Snags would be created through this treatment area by the fire. Stands will have reduced fire behavior in the event of wildfire, due to less surface fuels, higher canopy base height and lower canopy bulk density.

How are late successional T&E species affected?

Northern spotted owls (NSO) and marbled murrelets may be affected by Shasta Agness vegetation treatments. Marbled murrelet is expected to get a not likely to adversely affect (NLAA), due to seasonal restrictions to prevent noise disturbance in adjacent habitat. Marbled murrelet habitat has not been identified within density reduction treatment units. There is unsurveyed, suitable marbled murrelet habitat within the burn-between areas. Project design criteria are in place to protect habitat during potential prescribed fire operations.

No nesting murrelets have been documented within the planning area, but occupied sites are located within the 1.3-mile wildlife analysis area buffer. Vegetative and under-burn treatments could occur on approximately 5,700 acres within marbled murrelet critical habitat units. Most of the treatment areas are dry sites on south aspects with very little wet coastal species like western hemlock. However, they are still within marble murrelet habitat and may provide habitat someday. In the long run treatments that are reducing stand density and creating edges in canopy are likely to produce larger trees with larger live limbs. This will likely accelerate development of murrelet habitat in some portions of the sugar pine stands, oak woodlands, and plantation treatments. Depending on the frequency and intensity of repeated entry with prescribed fire for maintenance, this may reduce the recruitment of trees to provide cover (from corvid predation) for these larger branches that would develop.

Table 5. Summary of effects to spotted owl habitat

Current Habitat	Post-treatment Habitat	Acres - habitat removal	Acres – no habitat change
Dispersal	Dispersal	0	4043
	Non-habitat	487	0
Non-habitat	Non-habitat	0	1199
Nesting, roosting and foraging (NRF)	NRF	0	982
	Totals	**487**	**6224**

Treatment totals do not include POC sanitation treatment areas. All POC sanitation treatments will maintain current habitat.

Northern spotted owls are expected to receive a likely to adversely (LLA) determination from USFWS, due to removal of dispersal habitat by reducing canopy cover below 40% on approximately 490 acres. The home range of one spotted owl site below viability thresholds (#288) would have ~100 acres of dispersal removed to achieve oak restoration. All NRF habitat will be treated and maintained as NRF (>60% CC). In spotted owl critical habitat unit #KLW-2 and 3, there would be nominal effects to primary constituent elements due to treating and maintaining NRF in oak restoration units, under-burning in NRF habitat and vegetative treatments in dispersal-only habitat within. Acceleration in the development of nesting habitat is expected, in addition to increasing stand resilience to wildfire and lowering risk of fire spreading to adjacent nesting habitat. Vegetative treatments would occur in dispersal-only habitat within 7 owl core areas.

Dead wood

Down dead trees (down wood) and standing dead trees (snags) are a critical component on the landscape when managing forest ecosystems. While snags and down wood need to be considered at multiple scales, it is recognized that at the stand scale there are tradeoffs between benefits of heavy reductions in stand density and dead wood. At this scale, the proposed actions will reduce recruitment of dead wood for many decades. However, it is recognized that under natural conditions the density of snags and down wood varies over space and time. While reductions of down wood and snags will occur within treatment stands, these treatments will not considerably reduce dead wood densities below reference conditions.

DecAID - Down wood

As shown in Table 6, current small and large down wood is better than DecAID reference conditions except in Lawson Creek-Illinois River watershed. In that case, the percent of the watershed with no large down wood is 11% worse than reference conditions (75% versus 64%). This is because the 2002 Biscuit Fire burned a substantial portion of the Lawson Creek watershed, including at intensities high enough to consume large dead wood.

Table 6. Down wood conditions versus DecAID reference conditions as a percent of watershed.

Watershed	Percent of Watershed Without Small Down Wood (≥5" diameter)			Percent of Watershed Without Large Down Wood (≥20" diameter)		
	Reference	Current	Current vs. Ref.	Reference	Current	Current vs. Ref.
Lawson Cr.	27%	22%	5% better	64%	75%	**11% worse**
Shasta Costa Cr.	28%	14%	14% better	65%	53%	12% better
Stair Cr.	28%	12%	16% better	66%	50%	16% better
Bold red = Current condition does not meet DecAID reference condition.						

DecAID - Snags

As shown in Table 7, current small and large snags are worse than DecAID reference conditions in all watersheds; ranging from 6 to 20 percent below reference conditions for the amount of the watershed without measured snags. Large snags range from 8 to 20 percent below reference conditions. When small snags are added in, the range is from 6 to 13 percent below reference conditions.

Lawson Creek is departed the furthest (20 and 13 percent respectively of large and small snags), likely due to high intensity fire during the 2002 Biscuit Fire which consumed many large snags. At 8 percent each, Shasta Costa and Stair Creek watersheds are not substantially worse than reference conditions. In all watersheds, the deficit in snags was well distributed across the various quantities of snags per acre reported in DecAID histograms.

Table 7. Snag conditions versus DecAID reference conditions as a percent of watershed.

Watershed	Percent of Watershed Without Small Snags (≥10" DBH)			Percent of Watershed Without Large Snags (≥20" DBH)		
	Reference	Current	Current vs. Ref.	Reference	Current	Current vs. Ref.
Lawson Cr.	12%	25%	**13% worse**	27%	47%	**20% worse**

Watershed	Percent of Watershed Without Small Snags (≥10" DBH)			Percent of Watershed Without Large Snags (≥20" DBH)		
	Reference	Current	Current vs. Ref.	Reference	Current	Current vs. Ref.
Shasta Costa Cr.	13%	20%	**7% worse**	28%	34%	**8% worse**
Stair Cr.	13%	19%	**6% worse**	28%	34%	**8% worse**
Bold red = Current condition does not meet DecAID reference condition.						

Site level context

Within treatment stands, standing dead and downed wood are generally at low levels. Most snags are within the smaller diameter classes, likely due to competition in overcrowded stands. There is a lack of very large (≥ 30-inches dbh) snags across the treatment stands. Large snags that do occur in treatment stands are generally caused by droughty soils or diseases such as Port-Orford-cedar root disease (*Phytophthora lateralis*) and white pine blister rust (*Cronatium ribicola*).

It is important to consider the historic dead wood conditions when these stands were being maintained with frequent fire. The oaks stands were maintained with frequent fire, preventing conifers from reaching high densities and also consuming dead wood that may have been created in previous burns. Fire returning regularly in early successional and younger forest stand conditions can lead to dead wood legacies were typically much lower and composed of smaller pieces (Corn and others 1988) (Spies and Franklin 1989) (Nonaka and others 2007). These vegetation communities with frequent fire persisted in lower stand densities and less overall downed wood. This context must be considered when considering management strategies and effects to downed wood and snags within this particular ecosystem. Snags and downed wood can be created and alternatively consumed by fire processes.

Sampled stands and snag densities were modeled over a 100 year period to compare the effects of the density management treatments on long term recruitment of snags. This modeling compared no action, cutting trees 0-28" DBH (Alternative 1), and cutting trees 0-20" DBH (Alternative 3). Treatments in the oak stands would have a long term effect on snag density in treatment areas due to larger reductions in stand density and fewer Douglas-fir trees per acre. This has two effects, there would be fewer Douglas-fir to become snags and competition based mortality would be minimal until stand density reaches approximately zone of competition based mortality (relative density >55). In 2057, FVS projects that the alternative 1 would have 1 snags > 20" DBH, alternative 3 would have 2 snags > 20" DBH, and no action would result in 6 snags >20" DBH. When looking at the >20" snag data from DecAID, proposed treatments would contribute towards continued small deficits in the >2 large snags per acre landscape percentages. (See Appendix Figure 28)

In oak restoration treatments, a maximum of 2000 acres would be affected by these treatments thereby it would affect potential areas for dead wood by about 3% in Shasta Costa and 1.7% in Lawson Creek watersheds. Within these watersheds, 97% of lands are in federal ownership with the vast majority of the areas being designated as reserves, and 39-53% of watersheds are in a late-seral condition. Given this context, reducing dead wood recruitment on a contributing percentage of watersheds by a spatial area of 3% and 1.7% is an acceptable tradeoff to restore important habitat types and species diversity. Prescription considerations (below) for snags and down wood would also help reduce the effect of treatments on dead wood.

The 100-year DecAID modeling results for the sugar pine projects are very similar to the serpentine pine simulations. Smaller size of trees and retention of a higher number of leave trees per acre results in smaller differences in large snag (>20”) creation over time. Snag densities are about 50% lower in treated stands until about 2077 when snag levels increase to levels that are close to the no action. (See Appendix Figure 29 and Figure 30)

The serpentine and sugar pine restoration treatments, a maximum of 1100 acres would be affected by these treatments. Thereby it would affect potential areas for dead wood by a spatial extent of about 2.4% in Shasta Costa watershed. Within this watershed, 97% of lands are in federal ownership with the vast majority of the areas being designated as reserves, and 53% of watershed is in a late-seral condition. Given this context, some reduction of the dead wood contributions from a spatial extent of 2.4% percentage of watershed to restore this important forest type is an acceptable tradeoff. Prescription considerations (below) for snags and down wood would also help reduce the effect of treatments on dead wood.

The serpentine and sugar pine restoration treatments, a maximum of 1000 acres would be affected by these treatments. Thereby it would affect potential areas for dead wood by about 2.4% in Shasta Costa watershed. Within this watershed, 97% of lands are in federal ownership with the vast majority of the areas being designated as reserves, and 53% of watershed is in a late-seral condition. Given this context, some reduction of the dead wood contributions from a spatial extent of 2.4% percentage of watershed to restore this important forest type is an acceptable tradeoff. Prescription considerations (below) for snags and down wood would also help reduce the effect of treatments on dead wood.

Prescriptions and dead wood considerations

The prescription would incorporate strategies to protect and recruit dead wood. Achieving the desired density reduction to achieve objectives will result in reductions of down wood over the long run, but they must be considered in scale and context. For example, the proposed action would result in less dead wood in treatment stands over time, but species diversity, large trees, and landscape heterogeneity would be improved. While dead wood would be lower in treatments stands relative to no-action conditions, the landscape is above reference conditions in most size categories for down wood. Snags are deficit across the landscape, and mitigation for this can be addressed in the prescription. The proposed mechanical treatments would retain any existing snags and down woody debris, but the prescribed fire may create new snags while also reducing some existing dead wood. Site specific prescriptions will focus on maintaining and creating snags in riparian areas, skip patches, and interior unit areas away from roads and potential holding lines for prescribed fires.

Prescription considerations for snags and dead wood:

- Existing dead wood; standing and down - Avoid and protect existing snags and down wood ≥12 inches dbh to the greatest extent possible. Use treatment skips to avoid damage or their removal. Retain on-site all existing down wood.
- Locate skips where mature forest structures exist, within riparian areas, and where higher concentrations of snags and down wood are present.
- When applying release treatments around white and black oak, Douglas-fir that would damage, or necessitate felling oaks would not be removed. These trees would be topped or girdled and left.
- Douglas-fir with *Phellinus pini* will remain in stands if it is not a danger tree along open roads.
- Leave adequate number of trees in density management treatments (see Ecology plot data by plant series, Table 25 & Table 26), to provide for recruitment of snags and down wood. Use the criteria above for prioritizing where these dead wood would be located.

- Monitor tree mortality following prescribed fire treatments and create snags as needed following treatments. Ecology plot data would be used to determine quantities of dead wood by plant series. These values would range from 2-5 large snags per acre and 0-200 linear feet per acre for large down wood. See appendix for values Table 25 & Table 26.

Conclusion

Shasta Agness project proposes many different silviculture actions within LSR. Many are exempted and recognized by the Southwest Oregon Late – Successional Reserve Assessment (USDA Forest Service and USDI Bureau of Land Management 1995) as important actions to promote and conserve late-successional forests, maintain biodiversity, and restore important unique habitat types. This restoration project proposes actions that align with ecosystem management model and would be consistent with LSR objectives.

The spotted owl recovery plan recommends that spotted owl management decisions be implemented within a broader landscape approach based on the conservation of natural ecological patterns and processes (USDI Fish and Wildlife Service, 2011). One of the strategies and topics of the recovery plan emphasizes that ecological forestry and active forest restoration should occur to meet the challenges of climate change and altered ecological processes. Shasta Agness would follow this strategy, while conserving quality habitat and improving foraging conditions for spotted owls on this landscape.

The treatments above are proposed in LSR because they are considered necessary to restore ecological processes to these stands to promote a late-successional forest that is diverse and structurally complex. Douglas-fir/tanoak forests are common, and this project focuses on the restoration of uncommon, diverse forest types that should be maintained on this landscape to provide landscape scale heterogeneity and unique biodiversity. These diverse forest types provide mast production, species diversity, and variable forest structures in the larger context of the Fishhook LSR. Measures described above would be taken to promote both unique habitats and development of late successional forest attributes. Therefore, this proposal is consistent with LSR objectives, and would improve ecosystem function and promote complex and diverse late successional forests.

Sincerely,

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Rob MacWhorter
Forest Supervisor
Rogue River – Siskiyou National Forest

Appendix – Consistency Review In-Depth

NWFP and Land Management Direction

The following sections outline management direction, objectives, and guidelines that are specific to vegetation treatments in LSR.

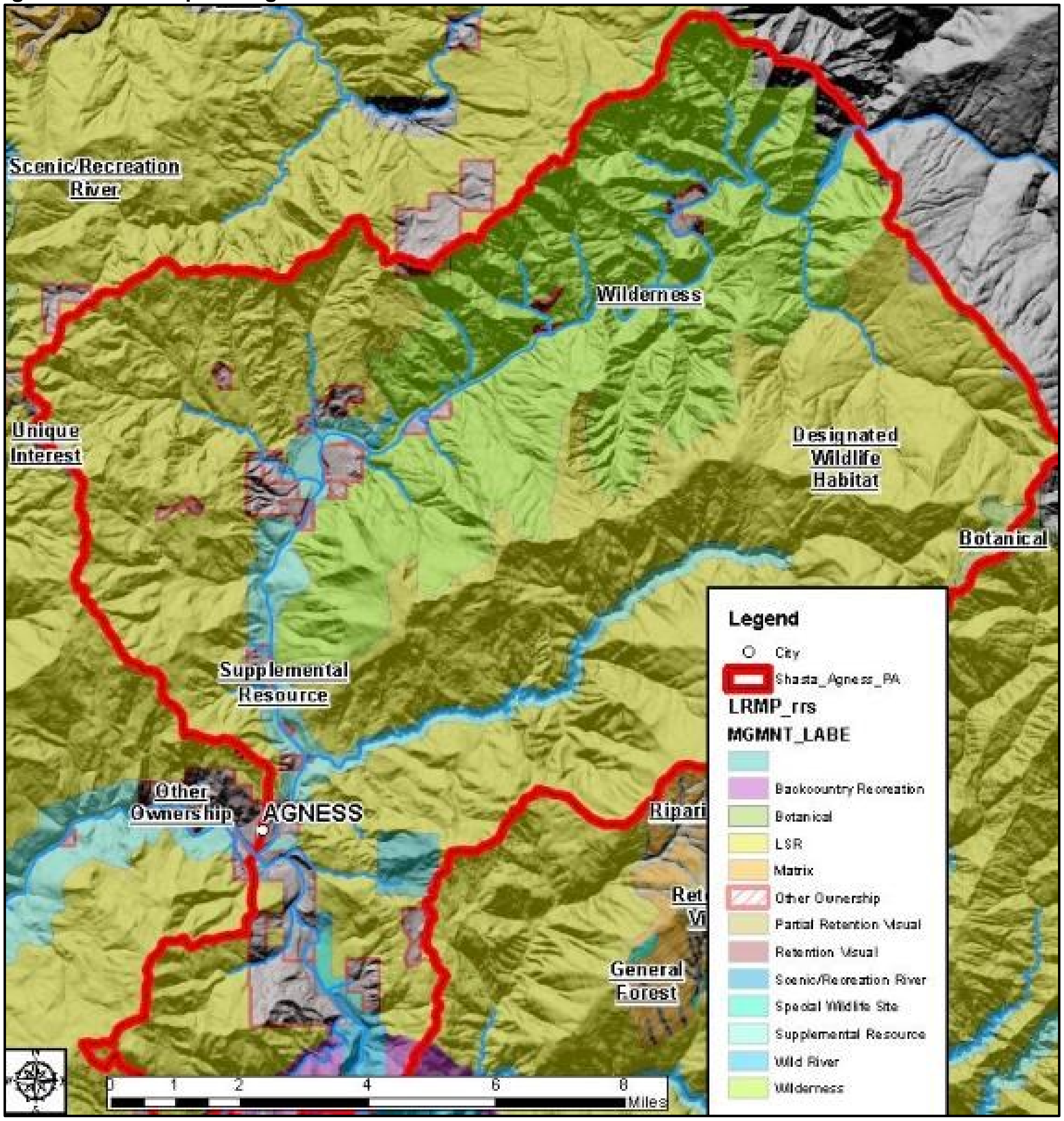
Table 8. Siskiyou LRMP – Land use allocations and proposed action

LRMP - Land Use Allocation	Acres	% of planning area	Alt 1 - Acres treated	Alt 1 - % LUA treated
Backcountry Rec.	1243	1.3%	0	0.0%
Botanical	408	0.4%	3	0.7%
Late Successional Reserves	55729	60.4%	6257	11.2%
Scenic/Recreation River	2638	2.9%	421	16.0%
Special Wildlife Site	199	0.2%	0	0.0%
Supplemental Resource	1502	1.6%	284	18.9%
Unique Interest	260	0.3%	2	0.8%
Wild River	802	0.9%	0	0.0%
Wilderness	25214	27.3%	0	0.0%
Wilderness (BLM)	537	0.6%	0	0.0%
State - ODF	599	0.6%	0	0.0%
Private	2718	2.9%	0	0.0%
BLM	358	0.4%	0	0.0%
Grand Total	**92207**		6967	7.6%

Siskiyou N.F. Land and Resource Management Plan

The Siskiyou National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service 1989), was amended by the Northwest Forest Plan (NWFP) (USDA Forest Service and USDI Bureau of Land Management 1994). For details on affects to Late Successional Reserve (LSR) allocations, see the section below on the Northwest Forest Plan. Vegetation treatments are proposed within the following land use designations from the Siskiyou LRMP listed in Table 8. Special Wildlife Sites (MA-9) are entirely overlaid by LSR and Supplemental Resource management area. Special Wildlife Sites are habitat or botanical sites which are important components of overall wildlife habitat diversity and botanical values (USDA Forest Service 1989) (IV-113). These sites addressed by this project include meadows, meadow buffers, and hardwood sites. The LRMP directs that all meadows should be managed as natural openings, and where opportunities exist, past encroachment by surrounding forest should be reversed. The proposed treatment areas overlap this designation on 1144 acres in the planning area. These special wildlife sites and the relationship to LSR are addressed in the Southwest Oregon Late – Successional Reserve Assessment, and discussed in more detail below.

Figure 2. LRMP in planning area



Late Successional Reserves (MA-8) & NWFP

Most of the vegetation treatment areas (6257 acres) are within the Late Successional Reserve (LSR) land use allocation designated by the Northwest Forest Plan. The Northwest Forest Plan designated Late Successional Reserve with objectives to protect and enhance conditions of late-successional and old growth forest ecosystems. According to the Northwest Forest Plan, the four major structural attributes of old-growth Douglas-fir forests are: live old-growth trees, standing dead trees, fallen trees on the forest floor, and logs in streams. Additional important elements typically include multiple canopy layers, smaller understory trees, canopy gaps, and patchy understory (USDA Forest Service and USDI Bureau of Land Management 1994). Since the majority of the project is within LSR, maintaining elements of these late-successional characteristics within treatment stands is important.

Objectives specified in the Basis for the Standards and Guidelines (B1-B-5) are being addressed by this project:

- The intent is to maintain natural ecosystem processes such as gap dynamics, natural regeneration, pathogenic fungal activity, insect herbivory, and low-intensity fire. (B-1)
- **In some forest types subject to frequent, low-intensity fire, such as ponderosa pine, the late-successional and old-growth stages are typically characterized by relatively open understories and relatively few large fallen trees (in comparison to more moist Douglas-fir/western hemlock types). (B-2)**
- Ecological processes include those natural changes that are essential for the development and maintenance of late-successional and old-growth forest ecosystems. Although the processes that created the current late-successional and old-growth ecosystems are not completely understood, they include: (1) tree growth and maturation, (2) death and decay of large trees, **(3) low-to-moderate intensity disturbances (e.g., fire, wind, insects, and diseases) that create canopy openings or gaps in the various strata of vegetation**, **(4) establishment of trees beneath the maturing overstory trees either in gaps or under the canopy,** and (5) closing of canopy gaps by lateral canopy growth or growth of understory trees. (B-2)
- These reserves represent a network of existing old growth forests that are **retained in their natural condition with natural processes, such as fire, allowed to function to the extent possible. (B-4)**.
- The reserves are designed to serve a number of purposes. First, they provide a distribution, quantity, and quality of old-growth forest and habitat sufficient to avoid foreclosure of future management options. Second, they **provide habitat** for populations of species that are associated with late-successional forests. Third, they will help ensure that late-successional **species diversity will be conserved**. (B-4)
- Silvicultural systems proposed for Late-Successional Reserves have two principal objectives: (1) development of old-growth forest characteristics including snags, logs on the forest floor**, large trees, and canopy gaps that enable establishment of multiple tree layers and diverse species composition**; and (2**) prevention of large-scale disturbances by fire,** wind, insects, and diseases that would destroy or limit the ability of the reserves to sustain viable forest species populations. Small-scale disturbances by these agents are natural processes, and will be allowed to continue. (B-5)

These stands also provide other benefits to the LSR that are not specifically emphasized in the Northwest Forest Plan standards and guidelines. This project emphasizes special habitat improvement within LSR, which include restoring open forest structures, improving flora species diversity, and restoring/maintaining important unique habitats in the project area. These special habitat improvement elements are addressed in the Southwest Oregon Late – Successional Reserve Assessment (USDA Forest Service and USDI Bureau of Land Management 1995).

The Southwest Oregon Late – Successional Reserve Assessment (LRSA) objective is to assess how well the western portion of southwest Oregon LSR network is functioning. Although each LSR is designed to include as much late seral forest as possible, and it should also provide for landscape scale connections and ecosystem analyses at the watershed scale to provide specific information on provincial pathways, patterns, structure, and disturbance dynamics (including associated risks) (LSRA pg. 9). In this assessment, the LSRA refers to areas called "Unique Habitats", many of which were identified as Special Wildlife Sites by the Siskiyou National Forest plan. The assessment also refers specifically white and black oak savannahs as unique habitats that were not mapped as Special Wildlife Sites (pg. 38).

Below is excerpt from the Southwest Oregon Late – Successional Reserve Assessment regarding unique habitats:

"On page C-17 of the Northwest Forest Plan, mention is made that "habitat improvement projects designed to improve conditions for … wildlife … should be considered if … their effect on late successional species is negligible." Maintenance of Wildlife Areas, BLM Elk Areas, and existing meadows (including Oak Savannah), plus reclamation of lost meadows would reduce the amount of potential late-successional forest in LSRs. Approximately 19,000 acres of these Unique Habitats exist in LSRs, and would not actually be maintained as late-successional habitat (these sites would provide a modicum of early-successional habitat interspersed throughout the LSRs in the assessment area). Due to poor soil and other conditions, an estimated 50 percent or more of the 19,000 acres in these habitat types would never produce quality late successional forest habitat. Thus, the potential "loss" (or "non-gain") of late-successional habitat in LSRs on federal lands in the assessment area is trivial and constitutes approximately 1.3 to 2.7 percent of the land base. Maintaining the viability of these habitat types has and would have little effect on late successional species inhabiting LSRs on federal lands in the assessment area. Maintenance of these habitat types does have an important positive impact: perpetuation of these wildlife habitats (and their attendant significant contribution to biological diversity)." (USDA Forest Service and USDI Bureau of Land Management 1995) (pg. 38).

The white oak savannah, meadows, and some of the serpentine savannahs would be considered open areas that would not be considered Douglas-fir, late-successional forests as defined by the NWFP. Outside of these open savannah vegetation types the project has an objective to manage for late successional structures. These late successional forest structures can look very different than traditional northwest, Douglas-fir old growth forests. In oak woodlands, this forest may be described as a late-open forest structure, with large white and black oaks, along with large Douglas-fir and ponderosa pine and an herbaceous understory. Oak savannahs may be described as open white oak savannahs with a ground cover dominated by grass and forbs. In serpentine savannahs, these areas would also be described as a late-open forest structure, with Jeffrey pine, sugar pine, and incense cedar growing amongst a patchwork of shrubs and open grassy areas. Sugar pine stands would be late-open stands of Douglas-fir, sugar pine, and hardwoods. Re-establishing and maintaining open areas, and reducing forest density to emphasize species diversity and forest heterogeneity is outlined as an important part of the Southwest Oregon LSR.

The LSRA outlines that maintenance of some of these unique habitats requires active management of the vegetation, and this vegetation may be other than late successional (different than traditional northwest old growth example) (pg. 38). The LSRA outlines that meadows (parts of the oak savannah and serpentine pine savannah stands) should be restored to their former size, and that the 1940s aerial photos could be used a historical reference point (pg. 39). The LSRA addresses black and white oak as unique habitats. Some of these have been mapped as special wildlife sites, and other have not been mapped. The LSRA estimates that as much as 2000 acres of oak savannah may have been missed in special wildlife site mapping. It specifically mentions oak savannah complexes on south-facing slopes of Shasta Costa Creek, Fall Creek, and areas around Big Bend and Oak Flat (pg. 39). These are the center of the focus for all of the oak restoration areas in this project. Serpentine pine savannahs are also mentioned as unique habitats in the LSRA (pg. 39), but are not described in detail.

Exemption criteria – LSRA

The LSRA identifies several silviculture activities that are allowed within this LSR. It generally lists that projects consist of prescribed fire, large woody material and snag recruitment, silvicultural treatments, *Phytophthora* control (POC), unique habitat restorations, wildfire, maintenance of lookout seeing corridors and other non-silvicultural activities (pg. 62). These include the following exempted activities. Application to this project is briefly described in italics.

A. **Prescribed fire and Wildfire Hazard Reduction (pg.62**) - applicable statements:
    a. The use of prescribed fire restores processes that have been limited by fire exclusion. *Shasta Agness project proposes extensive use of prescribed fire across most treatment areas, as a critical part of this restoration effort.*
    b. Line officers are responsible for considering the use of fire in the management strategy for appropriate ecosystems. Prescribed fire may be useful in the following land management activities:
        i. Site preparation – *Shasta Agness application* - *site prep for planting of desired tree species, seeding of grasses and pollinator species, and for maintenance burns.*
        ii. Control of undesirable understory including thinning - *apply fire to reduce composition of understory trees and shrubs*
        iii. Reducing activity and natural fuels - *reduce fuels to reduce risk of losing late-successional forests to stand replacement wildfire.*
        iv. Vegetation management for range and wildlife habitat - *encourage development of vigorous herbaceous and grassy understory which is valuable forage for many wildlife species. Improve conditions for regeneration of oaks and pines, both of which are valuable to many wildlife species (including prey for NSO) for the mast production.*
        v. Control of insects and disease - *site preparation for planting of disease resistant 5-needle pines.*
        vi. Maintaining a certain successional stage - *prescribed fire will restore and maintain open habitat types like oak savannah and serpentine savannah. Prescribed fire will also help establish and maintain early successional species in late-successional forest with a late-open structure. Reduction of risk from fire would result in higher probability of maintaining late-successional forests.*
        vii. Managing nutrient reservoirs and cycles for site productivity - *reintroducing fire to fire-dependent forest types to facilitate natural nutrient cycling processes that have been absent from these forests.*
    c. Burn plans will be prepared and approved in advance.
    d. Air quality needs will be addressed in burn plan (*7 items to consider are listed in LSRA, and will be addressed in burn plans*)
    e. <u>Priority areas for treatment:</u>
        i. Use prescribed fire where overstory is at risk of in wildfire due to understory fuel structure. Use prescribed fire where these conditions exist to reduce risk of losing late-successional forests to wildfire. *Use of fire in stands will reduce the risk of losing late-successional characteristics within treatments and*

potentially protect surrounding late-successional forests by providing conditions that improve fire suppression success.

ii. Prescribe fire on the Jeffrey pine plant series to simulate the historic fire frequency with which the plants evolved. In those areas, recycling of nutrients due to fire will provide historical conditions under which many of the rare plants evolved. *This project is looking at these plant communities, due to observed departure.*

iii. Prescribe fire on wildlife sites, especially meadows and oak/pine savannas, to maintain their habitat characteristics. Prescribed fire is an appropriate treatment of these small areas important for habitat diversity. *This project is focusing prescribed fire in exactly these types of habitats.*

B. **Silviculture Activity (pg. 65) –** applicable statements:

a. Many silvicultural activities can help achieve LSR objectives. Such activities include thinning, release, under-planting, limiting the understory, creation of snags, planting, and possibly fertilization. *Silviculture on the majority of the acreage would focus on these treatments to achieve desired late-successional characteristics.*

b. Thinning… with objective to (1) development of old-growth forest characteristics…(2) prevention of large-scale disturbances… - *Yes these are objectives of treatments.*

c. Thinning should focus on both conifer and hardwood species to encourage the development of diverse stands. *Intensive focus of this project is to develop diverse stands with oaks, pines, other hardwoods and a diverse understory.*

d. Consider riparian areas for thinning (especially upstream of the productive "flats") if it meets the Aquatic Conservation Strategy. *We are applying riparian thinning within treatment stands with project design criteria to meet objectives of ACS.*

e. Analyze opportunities to reduce density through the use of prescribed fire. – *Within treatment stands and within prescribed fire areas, density reduction would likely occur with the use of fire.*

f. Thin to stocking levels that promote the development of late-successional characteristics (canopy gaps, multistoried, some large limbs, etc.). Leave the most dominant trees along with the co-dominant and intermediate trees necessary for structural diversity. Maintain all species on site. *Prescriptions would leave the largest trees, promoting complex stand structures, and promoting species diversity.*

g. Manage southern aspects to incorporate disturbance considerations and favor predominately single layer stands. *Almost all of the natural stands proposed for treatments are on southern aspects.*

h. **Underplanting:** Underplanting can be important for creating multiple canopy layers, especially in managed stands. Underplanting as part of the thinning prescription of managed stands or stagnant stands accelerates the development of canopy layers. Criteria for underplanting include:

i. Emphasize northern aspects with LIDE3 plant series or anywhere where TSHE, ABCO, ABMAS, or CHLA plant series exist.

ii. Where appropriate, plant resistant improved stock of Sugar Pine, Western White Pine and Port-Orford-cedar to assure the presence of these species in future stands. *Planting of these species plus white and black oak are proposed.*

i. **Limiting understory:** Limit the amount of understory vegetation to prevent stagnant stands, or to protect stands at high risk of fire and/or insects/disease. Criteria for this treatment are:

   i. Emphasize density management of the understory where the overstory ponderosa pine, white pine, or sugar pine is at risk to active beetle attack. *Proposed prescriptions would reduce overstory and understory around pines using mechanical and fire treatments.*

   ii. Emphasize management of the understory where fire suppression has left ladder fuels in areas of high fire risk (such as southern slopes). *Most of the treatment stands are on southern slopes, and ladder fuels will be greatly reduced by treatments.*

   iii. Treat areas of high value first (adjacent to large interior blocks of habitat, or other areas listed on Table 21 in LSRA). *These large blocks of burn block treatments would reduce risk and improve chances of suppressions success to prevent the spread of fire into large blocks of adjacent late successional forests.*

   iv. Maintain natural hardwood distribution and abundance. *This one of the main objectives for the oak treatments.*

j. **Creation of snags and large woody material:** The creation of snags in managed stands provides a missing element of late-successional forests. The recruitment of large woody material, including snags, will be a part of every thinning prescription, where appropriate. *Skips, snag recruitment considerations, and snag creations are all elements of the prescriptions addressing dead wood.*

C. POC Phytophthora control (pg. 69) - applicable statements:

a. Site specifically analyze options to lower the risk of infection.

b. Options can include road management, sanitation, moisture conditions for operations, trees spacing, planting POC, and other appropriate measures. *All of these measures and more POC management practices from the 2004 POC ROD would be implemented.*

c. Implement research results to prevent the spread of the disease.

D. REO response – additional criteria for POC Phytophthora control (Regional Ecosystem Office Review of the "Southwest Oregon Late-Successional Reserve Assessment, 1996). The following section describes criteria (in addition to those in the LSRA) that must be met for silvicultural treatments for purposes of Phytophthora control to be exempted from REO review. Treatments not meeting the criteria remain subject to REO review. The REO may develop additional exemption criteria for phytophthera control throughout its range. Silvicultural treatments to control phytophthera within the LSRs addressed in the LSRA are exempted from REO review where the following criteria are met:

a. An interdisciplinary team conducts a site-specific analysis considering both silvicultural and nonsilvicultural control methods. If silvicultural treatment is found to be the preferred control method, a harvest prescription is developed by the interdisciplinary team for each proposed sanitation operation to ensure that it satisfies the objectives for LSRs and the Aquatic Conservation Strategy. For example, the prescription would ensure that LSR needs for large woody debris, snag retention, and riparian habitat are clearly met.

   i. *The general prescriptions have measures to protect LSR meet the objectives of the Aquatic Conservation Strategy. Measures include retaining appropriate canopy cover for NSO habitat and stream shading. There would be no removal of POC from riparian areas, and in upload areas only trees smaller than 20" DBH could be removed. See* ***Error! Reference source not found.****. See* ***Error! Reference source not found.*** *section for discussion on how down wood and snags.*

b. Amount (acreage or volume) of Port Orford Cedar (POC) and Pacific yew removed is substantially less than the amount that the sanitation treatments are designed to protect.
   i. *At most 240 acres of roadside sanitation would occur, which could protect up to 3500 acres of POC.*

c. Proposed treatments are part of a plan for containment of phytophthera that incorporates additional strategies (road closure, seasonal use restrictions, etc.) for reducing transport of infested soil or water.
   i. *Many POC management practices will be implemented as part of this project. Several roads that are potential vectors will be closed, disease resistant planting will occur, seasonal restrictions, and other measures will be taken to promote POC on this landscape. See* ***Error! Reference source not found.****.*

d. Roadside brushing and sanitation logging treatments prohibit removal of POC and yew further than 100 feet upslope and 200 feet downslope from the road.
   i. *POC will only be removed 25 feet upslope and a maximum of 100 feet downslope along streams.*

e. Within Riparian Reserves, treatments remove POC and yew no further than 100 feet upslope from the stream or associated high-risk topography.
   i. *Within riparian reserves, no POC would be removed from riparian reserves.*

f. Within Riparian Reserves, treatments do not exceed minimal levels of vegetative and soil disturbance, and soil and slope stability concerns are given preference over sanitation objectives.
   i. *Within riparian reserves, no POC would be removed from riparian reserves.*

E. **Unique Habitat Restorations (pg. 69) -** applicable statements:
   a. Meadow and oak savanna habitat in the late-successional reserves are important elements for some rare plants and habitat diversity. Maintenance of these areas ensures this habitat continues to function and provide biological diversity. Though the maintenance of this habitat is contrary to late-successional conditions, the limited area, arrangement, and importance of this habitat niche does not adversely impact the objectives of the late-successional reserves, and does improve ecosystem resilience by increasing diversity. In all LSRs, these meadow habitats

comprise less than 2% of the land area and often do not have the potential to grow late-successional forests.

b. Criteria for oak savannah and meadow restoration and maintenance are:
    i. Remove encroaching trees and undesirable exotic vegetation from meadows and savannas. *These actions are proposed in the oak savannah and oak woodland treatment portion.*
    ii. Leave or girdle large, live trees within savannas and meadow areas, depending on individual circumstances. Removal of tree excess to habitat needs may be necessary to meet objectives. *Girdling is proposed for trees larger than 28" DBH, trees that can't be felled without damaging oaks, and in other areas where amount of dead wood wouldn't be excessive for savannah forest types.*
    iii. Restore savannas and meadow areas lost to encroachment to their former size. This restoration affects the removal of some vegetation that has encroached upon meadows. *This is the primary objective of the oak savannah treatments.*
    iv. Reduce exotic species populations of gorse, scotch broom and purple lossestrife. *Treatment of exotic invasives is a primary concern and is already taking place in the project areas.*

The proposed treatments in portions of the project do not meet criteria that exempt certain commercial thinning projects in Late-Successional Reserves (LSRs) and Managed Late-Successional Areas (MLSAs) from review by the Regional Ecosystem Office (REO), pursuant to pages C-12 and C-26 of the Northwest Forest Plan *Record of Decision* (*ROD*). Since this project proposes treatments in stands older than 80 years old and cutting trees larger than 20 inches, it does not meet all of the exemption criteria. The cutting of trees larger than 20 inches can be determined consistent through the LSR workgroup review. Cutting trees older than 80 years of age in areas that aren't explicitly exempted from review or considered consistent per the criteria above requires a project specific plan amendment. Project-specific plan amendments are coordinated through a higher level review by the Regional Executives. These areas requiring the higher level of review include some of the oak woodland restoration, sugar pine, and serpentine pine treatments that propose to cut trees over 80 years of age. See Table 1above.

Port-Orford-cedar Forest Plan Amendment

The Record of Decision - Management of Port-Orford-Cedar in Southwest Oregon (USDA Forest Service and USDI Bureau of Land Management 2004) amended the Siskiyou LRMP to provide additional management direction for POC. The Port-Orford-cedar ROD describes the method for determining the risk of spreading the disease and identifying mitigation measures to reduce the risk. The objectives of these guidelines include:

- Maintain POC on sites where the risk for infection is low;
- Reduce the spread and severity of root disease in high-risk areas to retain its ecological function to the extent practicable;
- Reestablish POC where its numbers or ecosystem function has been significantly reduced.

Landscape context

The planning area consists primarily of Forest Service lands, most of which is LSR and Wilderness. Most discussion is included in the letter above. See Table 9 for ownership summary.

Table 9. Ownership summary

Ownership	Acres	% of planning area
BLM	895	1%
Private	2718	3%
State - ODF	599	1%
USFS	87996	95%
Grand Total	**92207**	

It is important to note that the majority (6009 of the 6967 acres) of the proposed treatment areas would be managed to promote late successional conditions that maintain and promote important minor species, late-open stand structures, native plant communities, and natural ecological processes. In the oak and pine treatment portions of this 6009 acres, there would be tradeoffs for certain late successional components. Certain components like species diversity, large trees (although fewer per acre), and multiple canopy layers would be promoted through these restoration treatments, but this would result in less down wood and snags over time. With this in mind, late seral forests in this project area existing under a natural/historic fire regime would likely look very different than many of the late-seral forests with very infrequent fire return intervals. 958 acres would be managed to maintain or restore open habitat types (not late-successional) that are minor, yet important habitat types across the landscape. These open savannah habitat types and their ecological importance are mentioned explicitly in the Southwest Oregon LSRA (USDA Forest Service and USDI Bureau of Land Management 1995).

Abiotic conditions

This 92,000 acre planning area consists of highly variable terrain, geology, soils, climate, and resulting in highly variable and diverse vegetation patterns and composition. This diversity, resulting in part due to these highly variable abiotic conditions, has resulted in these unique ecosystems that are a very important part of the overall ecosystem function.

The planning area is located in the Shasta Costa – Rogue River, Lawson Creek – Illinois River, and Stair Creek – Rogue River watersheds in Gold Beach Ranger District and Wild Rivers Ranger District. This planning area ranges from about 14-29 air miles from the Pacific. The ridge-lines that define the western boundary of the planning area are a transition zone for vegetation communities on the landscape. The Pacific Ocean's cool, moist maritime influence prevails to the west, and the warmer, drier interior environment of the Klamath Mountains predominates to the east.

Precipitation amounts vary from about 70 inches annually to around 120-150 inches in the higher elevations. The upper elevations of the project area within the snowpack zone (above 4000 feet). The abundant moisture in project area is seasonal, with the majority of the precipitation occurring between October and May. June through September are most commonly dry and hot with in the project area. High temperatures in summer months in the Agness area often exceed 90 degrees F. The project area receives ample precipitation to support mesic species typical of the Pacific Northwest Forests further north in Oregon, however the hot, dry summers with little moderating marine influence, contributes to the presence of more xeric species. This is especially the case on south aspects and lower elevations within the planning area (oak stands).

This project area is located in the northern portion of the Klamath Mountain range, in Siskiyou Mountain sub-range. Just to the north of the planning area in the South Fork of the Coquille watershed, marks the transaction zone of the Klamath Mountains to the Oregon Coast range. The Klamath Mountains are geologically and biologically distinct from the Cascade and Sierra Nevada ranges, and are renowned for their exceptionally high levels of biological diversity (DellaSala and others 1999; Grace and others 2011; Whittaker 1954). The rugged topography and the diverse edaphic conditions, including the highest concentration of serpentine bedrock and soil in North America, contribute to the diversity found in this region (Damschen and others 2010; Grace and others 2011; Grace and others 2007).

Most of the sugar pine and all of the serpentine pine stands are growing in soils that are serpentine influenced. Serpentine soil is a common name for soils derived from ultramafic parent material, such as peridotite and serpentinite, and often harbors uniquely-adapted vegetation due to the low availability of major plant nutrients and high concentrations of heavy metals (Brady and others 2005; Kruckeberg 1954; Whittaker 1954). These soil types in the planning area harbor a wide variety of plant communities, due in large part to the highly variable geologic formations and parent materials. Soils derived from peridotite and serpentine are commonly shallow in depth, reddish, and nutrient-poor, and characterized by a high clay content and plasticity. Due to the limited capacity of these soils, there are many areas within stands that aren't capable of producing nesting roosting and foraging (NRF) habitat for northern spotted owls. Other areas in some of the sugar pine stands are capable of producing late seral forests that meet the NRF habitat needs of the northern spotted owl.

Many of the oak stands are located on south slopes with shallow soils. Areas where oak savannah still persist are often shallow soils with a mudstone parent material. These are xeric sites, with poor water storage capacity, resulting in a sites where larger conifers are not resilient to drought. California black oak and Oregon white oak presence is higher in soils characterized by a subsurface soil layer high in clay content and highly weathered (ultisols with an argillic horizon) or a weakly developed B horizon (inceptisols with a cambic horizon). Douglas-fir encroachment is occurring in these soil types, however Douglas-fir vigor is lower in these droughty soils resulting in slower encroachment and overtopping of the oaks than seen in other areas with better soils. Some open oak savannahs remain unsuitable for Douglas-fir regeneration or long term establishment. This is evident by lack of Douglas-fir regeneration and recent mortality around the edges of these white oak woodlands (see Figure 3). These soils transition into white oak and black oak woodlands with more suitable soils for Douglas-fir. Douglas-fir is well established and have long been overtopping oaks in these oak woodlands, however growth is relatively slow on these sites, and Douglas-fir show signs of reduced tree vigor, including common occurrence of *Phellinus pini.*

The soil conditions within some of these areas either cannot attain or sustain late successional characteristics suitable for NSO. These are the areas where heavier overstory removal, maintenance of current low overstory density, and NSO dispersal habitat removal are proposed. Areas adjacent to these soils are capable of growing a late seral forests. Prescriptions in these areas are proposed to maintain large conifer trees at lower densities in order to restore a late-open forest structure that supports oaks, pines, and the herbaceous plant communities associated with forest types. As indicated in the LSRA, these restoration actions were not anticipated to have an effect on the overall function of the LSR.

Forest structures and conditions must be considered in the context of a spatially complex landscape, with equally complex and diverse vegetation communities. In the Klamath Mountains, geology and resulting soils, disturbance history, and plant communities have all resulted in a complex pattern of vegetation and seral stages on the landscape. These treatments consider this landscape and the context these stands play in this ecosystem considering disturbance regimes, soils, and late seral forests.

Figure 3. Mortality in shallow soils in oak woodland

Landscape disturbance processes

Under a natural fire regime, more frequent fire would have maintained the forest structures in a more open canopy conditions. This concept is referred to as the Natural Range of Variability (NRV), which is defined as a frequency distribution of ecosystem characteristics, including the appropriate spatial and temporal scales for those distributions and a reference period, typically prior to European settlement. Seral classes and stand structures are currently out of balance in these watersheds with less early successional, mid-successional open, and late-successional open conditions than before European settlement. This means there is far more mid-closed and late-closed forest structures than would have existed under pre-European disturbance regimes. These closed canopy condition forests are not favorable to sugar pine vigor and resiliency, or recruitment of regeneration into the overstory.

Classifying this planning area as a mixed severity fire regime would be the most appropriate when looking at the planning area in entirety. A mixed-severity fire regime forest is one, where over space, mixed severity fires tend to naturally dominate, but not to the complete exclusion of occasional low- or high-severity fires over time. With high- and low-severity fires, >70% and <20% of the dominant tree basal area or canopy cover of a patch is killed by any single instance of fire, respectively (Agee 1993). Some of these areas may have incurred more frequent fire and would be better classified in the fire regime group I with frequent, low intensity fire. Tom Atzet, former Forest Ecologist for the Siskiyou National Forest, used ecology plot data and local information to estimate fire regimes by plant series for the Siskiyou National Forest. The Douglas-fir series classified as fire regime group I, with an average fire return interval of 15 years, with an estimated interval range of 1-20 years. The tanoak series is classified as fire regime group III, with an average fire return interval of 12 years, with an estimated interval range of 5-150 years.

Large scale regional assessments completed by Haugo and others (Haugo and others 2015) have identified the Shasta Costa – Rogue River and Stair Creek – Rogue River watersheds with a high need for disturbance restoration. According to their analysis, these watersheds are in the top 10 in the analysis area (Southwest Oregon and Eastern Oregon and Washington) for departure from NRV and are in need for disturbance to restore forest structure (Haugo and others 2015). This means that the current forest conditions are highly departed from forest conditions expected in the natural range of variability. Understanding the disturbance processes on this landscape helps indicate how these important, diverse plant communities were maintained. It also illustrates the risk of lost biodiversity that was reliant on this former level of pyrodiversity. Restoring the natural range of variability is not the objective of this project, but it helps tell the story of change on this landscape and how it looked previously.

While these landscapes may have departed from natural range of variability under a mixed severity fire regime, it is also critically important to preserve late-successional forests in this landscape. This project attempts to do that by implementing the management strategies recommendations from the Tamm Review: Management of mixed-severity fire regime forests in Oregon, Washington, and Northern California (Hessburg and others 2016). These management strategies are listed below. All of these strategies are being proposed in some form or scale in this project.

1. **Strategy (1)**: Landscape-level approaches to restoring pyrodiversity.
2. **Strategy (2)**: Protecting and restoring large and old, early-successional tree abundance.
3. **Strategy (3)**: Expanding use of prescribed and wildfires to restructure forests.
4. **Strategy (4)**: Using topography to tailor restorative treatments to the landscape.
5. **Strategy (5)**: Rehabilitating plantations.
6. **Strategy (6)**: Creating and maintaining successional heterogeneity.
7. **Strategy (7)**: Integrating restoration with late-successional forest habitat needs.
8. **Strategy (8)**: Mitigating threats from climate change, forest insects, and pathogens.
9. **Strategy (9)**: Creating and maintaining early-successional forests.

Oak stands

Oak stands development

The oak stands include stands where Oregon white oak and California black oak are present. These are mostly low elevation stands on south aspects, with elevations ranging from 300 to 1800 feet. Given the current conditions of conifers shading out oaks, resulting in oak mortality and stand conversion, fire was clearly a necessary disturbance to maintain oaks on many of these sites. While this planning area is considered to be in a mixed severity fire regime, frequent fire use by Native Americans was likely the disturbance that maintained these oak woodlands.

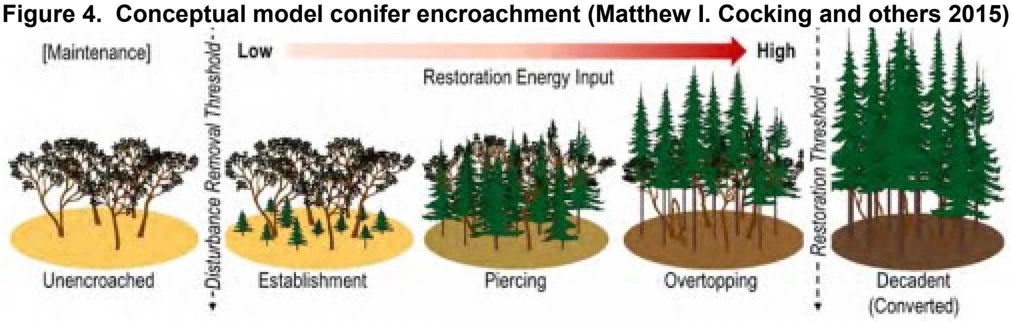
Native Americans, and specifically the Shasta Costa group (Tutuni band of Athapascans) lived between Oak Flat on the Illinois River and Big Bend. Anthropogenic (human-caused) fire was a major component of the Native system of land and resource management in what is now Oregon.

Native Americans actively managed landscapes with fire to manage food resources and manipulate food-producing environments (Boyd 2017). Native peoples enhanced vegetation and game supplies through the use of fire, burning grasses seasonally to keep the valleys and hillsides open (Gray and Atwood 2003). Their low-intensity ground fires extended the range of forest species that depended on a frequent fire regime, stimulated the growth of native grasses, and kept oak savannas intact by burning back encroaching conifers. This regular practice of burning by the Shasta Costa group likely ended sometime around the 1850s when the Rogue Indian Wars were occurring. Most of the Rogue River Indians were moved to reservations by 1856. Although direct evidence in this area is scarce and piecemeal, stand structures, species composition, and known history of the area suggest that many of lower slopes of the planning area were actively managed with fire by the Shasta Costa tribe.

Evidence that directly supports anthropogenic use of fire is observational and based on ethnographic accounts. Stand exam data that cored over 100 trees in the oak stands, only recorded 5 trees that were over 150 years old. These older legacy trees are present in some stands, and are obviously older from the tree size and crown structure that results from open grown conditions. The majority of overstory Douglas-fir in these stands are between 80-120 years old. Stand replacement events may have created these cohorts, but there is little evidence that these sites supported forests with higher density of Douglas-fir. A previous project estimated that majority of the oaks were between 150 and 200 years old. Using the fire regime groups developed by Hardy and others (Hardy and Burgan 1999), Tom Atzet classified Oregon white oak stands in southwest Oregon in fire regime group I, with a fire return interval of less than 35 years (USDA Forest Service and USDI Bureau of Land Management 2004). These oak woodlands likely were maintained by frequent fire, while the patterns of mixed severity fire in the watersheds indicates mixed severity and higher severity stand replacement events occurred on the upper ½ to 1/3 of the slopes. These oak woodlands were likely maintained with frequent fire by the Native Americans.

Deciduous oak woodlands, primarily those dominated by Oregon white oak (*Quercus garryana*) and California black oak (*Quercus kelloggii*), provide an example where removal of fire can result in the conversion from oaks to less fire-tolerant tree species, primarily native conifers. This process has been described variably as conifer invasion, forest densification, mesophication, succession, and conifer encroachment (Matthew I. Cocking and others 2015). When fire is excluded, proliferation and growth of conifers outpaces oaks resulting in eventual overtopping by conifers, and oak mortality (M. I. Cocking and others 2012; Devine and Harrington 2006, 2013; Engber and others 2011). Conifer encroachment often occurs as an initial wave (establishment stage), preceding additional successional development.

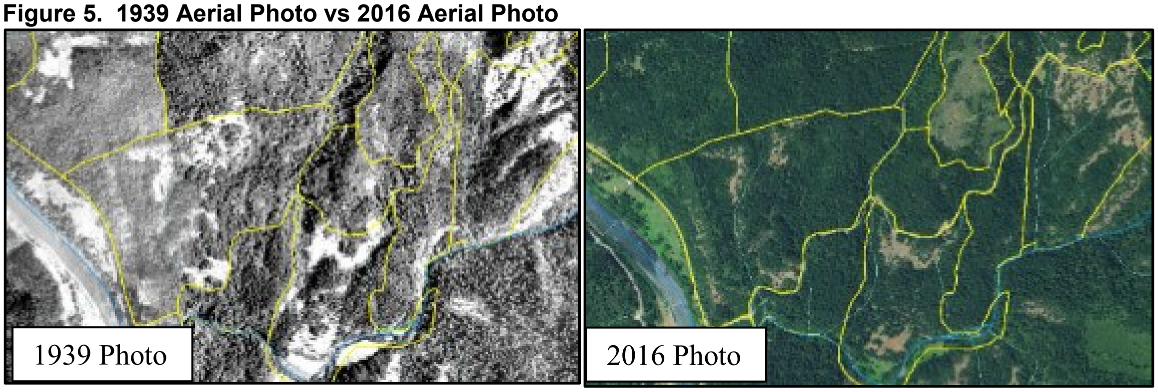
Figure 4. Conceptual model conifer encroachment (Matthew I. Cocking and others 2015)



Tanoak (*Notholithocarpus densiflorus*), evergreen huckleberry (*Vaccinium ovatum*) and other common Douglas-fir understory species succeed Douglas-fir encroachment in coastal oak woodlands (Sugihara and Reed 1987). Encroaching conifers can reach high densities (M. I.

Cocking and others 2012) especially in wetter climates (for example, Douglas-fir, Coast Ranges). As conifers ascend to the oak canopy (piercing stage), competition for sunlight between oaks and conifers becomes substantial, with Douglas-fir having the ability to grow through oak crowns without canopy gaps (Hunter and Barbour 2001). As conifers emerge above the woodland canopy, increased shade causes dieback of shade-intolerant oaks (overtopped stage). This often results in structural failure of oaks and eventual oak mortality in late stages of encroachment. A visual of this process is shown below in Figure 4.

Figure 5. 1939 Aerial Photo vs 2016 Aerial Photo



This overtopping and increased canopy cover of Douglas-fir in the planning area has resulted in oak mortality, which is most apparent in areas where some California black oak is still present. In these areas, many “bones” of dead black oak are present and black oak that are present have sparse canopies that reach for openings in the canopy. It is likely that white oaks had much higher composition and larger extent across the planning area, but the overtopping may have occurred 50-80 years ago, resulting in mortality for the shade intolerant white oaks decades ago.

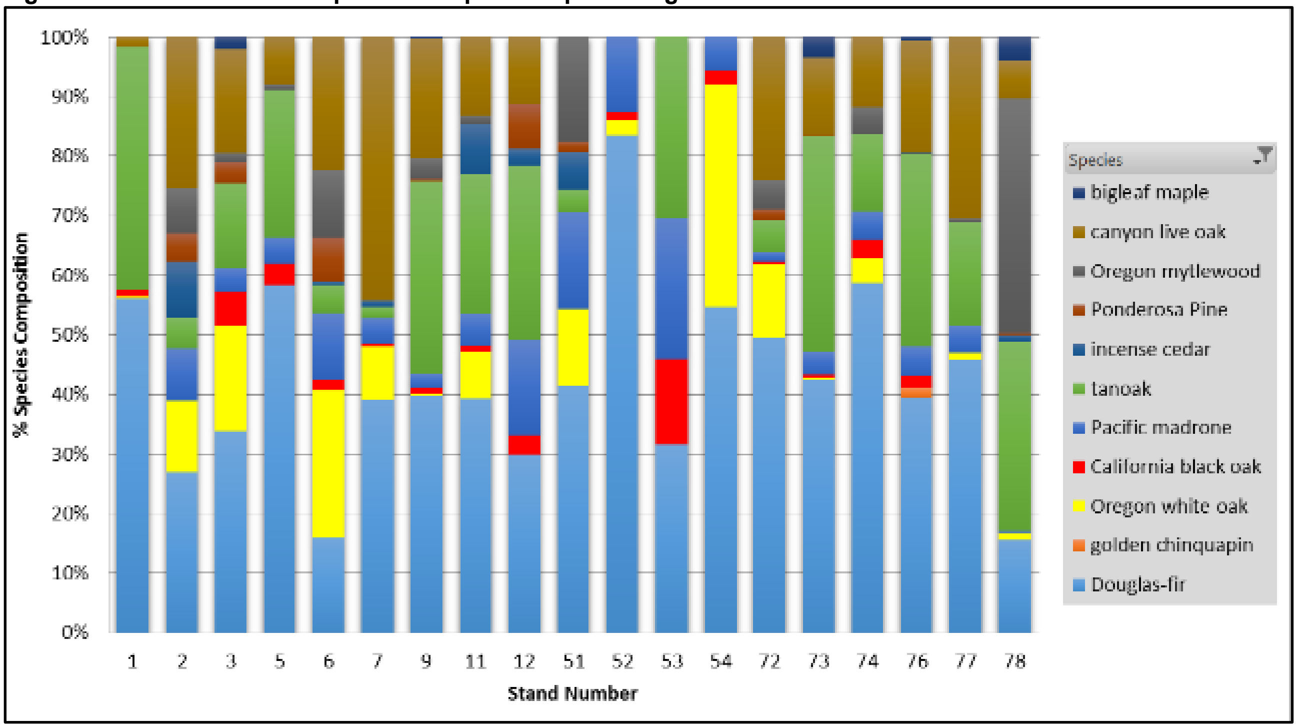
Figure 6. California black oaks in closed canopy stands

Oak stands composition

Distribution of oaks is very patchy within identified stands. In some areas you see oak white oak savannahs or oak woodlands where oaks make up the majority of species composition in trees per acre and canopy cover. In other areas Douglas-fir and tanoak dominate the canopy cover and trees per acre, with a few scattered oaks or remnants of dead oaks.

Species commonly found the oak stands in order of relative abundance (TPA) include: Douglas-fir (*Psuedotsuga menziesii*), tanoak (*Notholithocarpus densiflorus*), canyon live oak (*Quercus chrysolepsis*), Oregon white oak (*Quercus garryana*), Pacific madrone (*Arbutus menziesii*), incense cedar (*Calocedrus decurrens*), Oregon myrtlewood (*Umbellularia californica*), and ponderosa pine (*Pinus ponderosa*). In Figure 7, species composition percentage is displayed by trees per acre that are larger than 7 inches diameter at breast height (DBH). Oak species of emphasis include the Oregon white oak in yellow and the California black oak in red. Plant associations commonly found in these stands include: Tanoak - Douglas-fir- canyon live oak / poison oak, Douglas-fir – ponderosa pine / poison oak, Douglas-fir – canyon live oak / poison oak, Douglas-fir – California black oak / poison oak, and Oregon white oak – Douglas-fir / poison oak (Atzet and others 1996). All of these plant associations are generally occur on dry, warm sites.

Figure 7. Oak Stands - tree species composition percentage



Graph displays tree species composition percentage, using trees per acre. This only shows trees > 7 inches DBH.

Oak stands structure

The current structures are highly variable, but can be clumped into two primary categories. The first is the oak savannah forest structure, in which oaks provide the primary canopy cover, with large open areas of grassland. This stand structure will be referred to as an oak savannah. The second primary forest structure would be the closed canopy forest structure, which consists of a mostly even-aged stand overstory of Douglas-fir that has overtopped the oaks. This stand structure will be referred to a mixed oak woodland. In some stands (2, 3, 6) both of these stand structures were sampled under the same sample design, so certain metrics are averaged across both stand types.

The oak savannah forests overstory consists primarily of Oregon white oak. Canopy cover is highly variable, but varies between 15-60%. These areas also commonly have canyon live oak, ponderosa pine, and California black oak around the perimeters of the open areas. Douglas-fir encroachment has squeezed the open areas, but high levels of Douglas-fir mortality has also occurred in recent decades. This has resulted in numerous snags and large down wood within these oak savannah forests. Little to no oak regeneration has been observed in these areas. Some Douglas-fir and tanoak regeneration is established in these areas.

The mixed oak woodland forest type has highly variable stand structures. Canopy cover ranges from 56% to 77% with Douglas-fir constituting the majority of the canopy cover. However, canopy cover is much higher is some areas, as stand exam plots that were located in open savannah areas lowered these canopy cover results. There is often multiple canopy layers, with a Douglas-fir making up the overstory cohort, with black oak, white oak, tanoak, canyon live oak, and madrone in the midstory. There are scattered ponderosa pine that make a small composition of the overstory canopy cover. The heights of the Douglas-fir co-dominant cohort average 101 feet with a range of 59 to 133 feet. The midstory hardwoods heights vary from 15 to 80 feet. Regeneration consists mostly of hardwoods, and specifically tanoak and canyon live oak. Some Douglas-fir regeneration has established in some areas, but mostly closed canopy conditions inhibit growth. There are some larger legacy trees present within these stands, but they are not common. These legacy trees are older trees than the primary overstory cohort and were grown in open conditions before canopy closure occurred. Stands 5, 73, and 74 have the highest concentrations these trees.

Figure 8. Black oak woodland restoration stand #5 - current diameter distribution

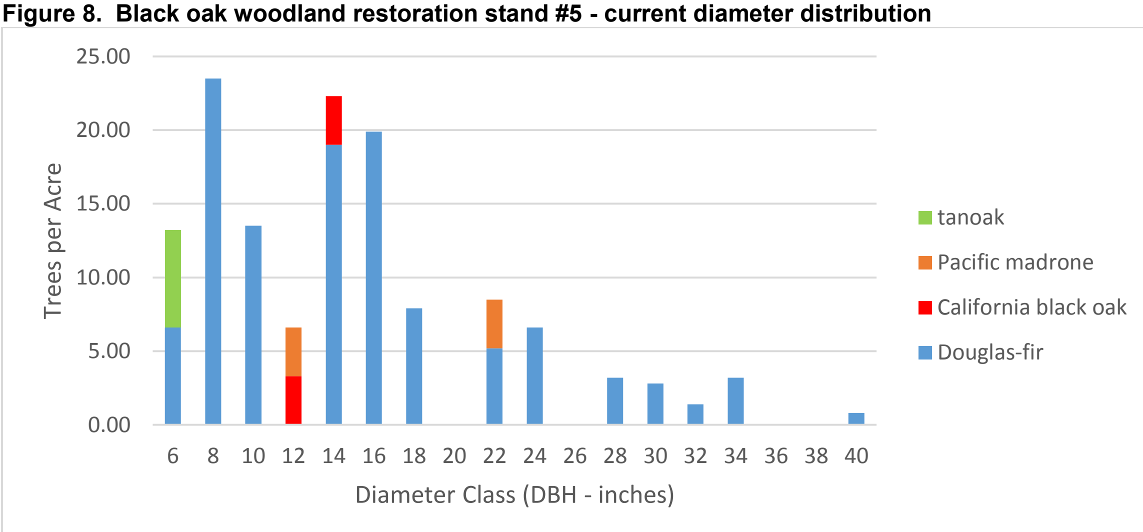
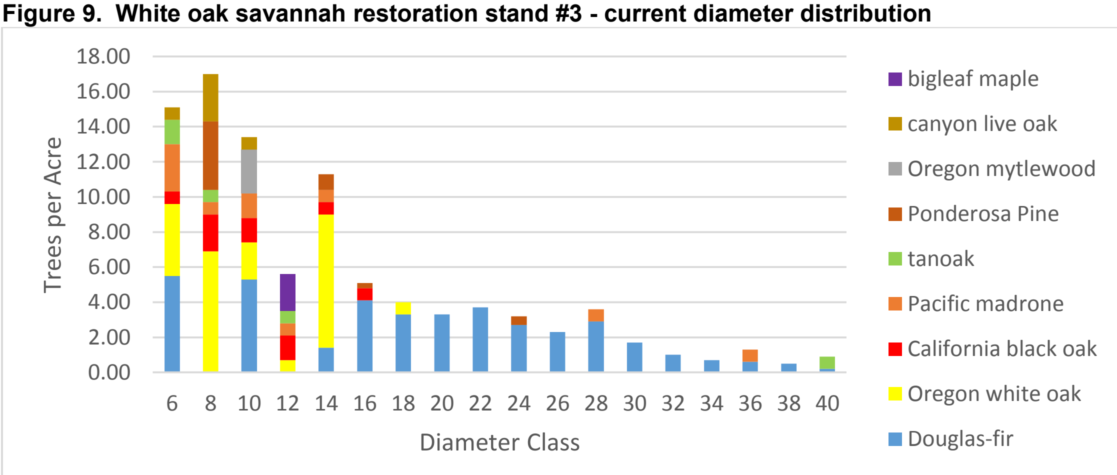


Figure 9. White oak savannah restoration stand #3 - current diameter distribution



The quadratic mean diameter (QMD) for treatment stands ranges from 11 to 25 inches. There is variation in diameters due to site quality and stand density variability. The average QMD for oaks stands is 17 inches for all trees and 19 inches when just measuring Douglas-fir. All QMD calculations only considered trees larger than 7 inches diameter at breast height (DBH). The tree ages are mostly pretty similar within each stand, but Douglas-fir DBH vary depending on the site quality. Poorer quality sites tend to have smaller Douglas-fir trees and have retained more oaks.

Table 10. Current conditions – stand metrics from sampled oak stands

Unit Number	Acres	Stand Average Age	Total TPA	Basal Area ft^2 /acre	SDI - Stand Density Index	Relative Density (Max SDI = 650-850)	QMD all trees >7" DBH (inches)	QMD DF trees >7" DBH (inches)	Top Height	Canopy Cover[1]
1	42	121	344	525	785	92	21.8	24.3	133	70
2	87	103	165	108	191	27	19.4	25	74	41
3	163	105	243	138	250	36	17.3	21.8	93	56
5	47	84	355	204	369	53	16.7	16.9	110	69
6	95	87	186	79	152	22	13.4	20	61	47
7	53	109	277	164	296	42	17.5	19	102	61
9	119	110	415	231	421	60	19.7	20.7	129	63
11	78	80	485	266	486	69	17.2	17	98	74
12	22	80	568	249	476	68	14.2	13.5	96	68
51	62	104	194	213	341	49	14.2	17	87	72
52	36	85	147	320	446	64	18.7	17.2	109	77
53	59	64	132	160	251	36	14.9	19.7	84	58
54	34	93	188	304	450	64	20.1	22.2	124	76
72	123	112	349	134	262	37	12.9	13.3	86	59
73	58	126	403	260	460	66	16.7	18	123	75
74	88	108	457	266	481	69	15.2	19.2	112	78
76	242	121	571	121	504	72	18.7	18.2	121	68
77	64	56	466	138	285	41	11	10.9	59	68
78	152	121	621	254	493	70	14.5	25	126	74
Averages		**98**	**346**	**218**	**389**	**55**	**17**	**19**	**101**	**66**

Abbreviations: TPA (Trees per Acre), DF (Douglas-fir), BA (Basal Area), SDI (Stand Density Index), RD (Relative Density) QMD (Quadratic Mean Diameter measured at breast height), CC (Canopy Cover – values calculated in Forest Vegetation Simulator).

Stand density index (SDI) values range from 152 to 785 with an average of 389. This results in a relative density range of 22% to 92% (given a maximum SDI value ranges of 650-850). Higher values of relative density indicate that the stand is growing in a high-competition environment, resulting in lowering of live crown ratios, slowing of diameter growth, and some competition induced mortality. Relative density values above 55% indicate intense stand competition is occurring. Such stands will potentially remain in a stem-exclusion stage (Oliver and Larson 1996) for extended periods, perhaps a century or longer (Andrews and others 2005), before mortality agents begin to create canopy gaps suitable for recruitment of understory vegetation and development of large crowns in overstory trees (Franklin and Van Pelt 2004). Relative densities levels above 35-55% will certainly continue to contribute to oak decline in these stands. Lower stand densities (SDI = 152, RD = 22%) exist in stand 6, due to many plots falling in open savannah areas and portions of the stand were previously clearcut. The basal area (feet^2/acre) ranges from 79 to 525 ft^2 /acre of basal area with an average of 218 ft^2/acre. This variation is mostly due to site quality and stand density variability.

Need for treatment

The need: Deciduous oak woodlands provide many ecological, cultural, and economic benefits, and often represent unique plant communities that harbor native rare and declining species. Oak woodlands have suffered substantial losses in area and ecological integrity in the post-settlement era due to land conversion and widespread fire exclusion (Matthew I. Cocking and others 2015). These particular oak associated ecosystems are rare at a global scale and provide habitat for several Sensitive and endemic Siskiyou Mountain vascular plant species. (*Cicendia quadrangularis, Erigeron klamathensis, Erigeron cervinus, Fritillaria gentneri, Trillium kurabayashii, Diplacus bolanderi, Adiantum jordanii, Triteleia hendersonii var. leachiae, Frasera umpquaensis*). These oak savannahs and woodlands exist on a relatively small scale on the landscape, with 2600 acres (2.8%) of savannah and oak woodland identified by special wildlife sites in the planning area.

Remnant oak woodlands in this planning area cover much smaller areas currently than during pre-European establishment period. In the absence of fire these low elevation, south aspect stands are transitioning away from an open canopy structure with diverse species composition that provides important heterogeneity on the landscape scale. This transition results in a homogenizing of patterns, structure, and species composition on the landscape. As Douglas-fir invades and increases forest canopy cover, the composition of oaks decreases due to competition based mortality. The process of conifer encroachment in this project area principally affects oak woodlands that were once co-dominated by Oregon white oak (*Quercus garryana*) and California black oak (*Quercus kelloggii*). Down wood and snags of dead black and white oak are common in closed canopy portions stands in the treatment areas, providing evidence of the transition occurring in these forest types. This project would address this conifer encroachment and attempt to restore the structure, composition and function these oak woodlands and savannahs provided in this ecosystem.

Why cut over 80 years of age? In the proposed action, 2019 acres of the 2199 acres identified for oak restoration have overstory Douglas-fir that are greater than 80 years old. Almost all of the overstory trees composing the majority of the canopy are over 80 years of age. Without cutting these trees to provide more sunlight to oaks and understory vegetation, shade intolerant oaks will continue to succumb to competition the dense overstory of conifers.

Why cut trees greater than 20 inches DBH? Partial release of oaks and opening of the overstory is possible with a 20 inch diameter limit. However, full release of oaks and canopy cover reduction would not be possible unless larger trees can be cut. A ten year study of Oregon white oak release found that response of oaks to half-release treatments were small, the growth response was not significant, and it is unclear for how long the acorn production will persist (Devine and Harrington 2013). The same study found that removing all conifers around oaks within one tree height (“full-release” treatments) significantly increased oak growth and acorn production compared with non-targeted thinning in encroached stands. Implementing full release treatments with cutting trees larger than 20” DBH up to 28” would create a better environment for survival and vigor of oaks, while also allowing for development of a late-open forest structure that maintains the a sustainable herbaceous plant community associated with these oak savannahs and woodlands.

How does this improve or benefit LSR and late-successional habitat? These treatments would restore heterogeneity by improving structural and species diversity, which would result in improved mast production and diverse habitat types for many wildlife species.

Oak savannah restoration would result in late-successional oak savannahs, which is not aimed to develop late-successional habitat specific to Northern spotted owl forest structure as defined by the NWFP. However, these oak savannahs are recognized in the SW Oregon LSRA as an important habitat type to restore for wildlife and for their contribution to biological diversity (USDA Forest Service and USDI Bureau of Land Management 1995) (pg. 38). The LSRA exempted these treatments, considering them to be Habitat Improvement Projects (C-17) in the NWFP. These open savannah forest types are a small part of the landscape, and restoring and maintaining these forest types would have a negligible effect to late successional forest and species. Approximately 850 acres of the 2200 acres identified for oak restoration are currently oak savannah or would be restored to oak savannah or oak woodland condition. This represents 0.6% of the Fishhook LSR and 1% of the planning area.

In the black oak areas (mixed conifer/hardwood forest) density reduction would occur to favor oaks, but treatments would retain the largest trees to promote development of a late-open forest structure. Treatments would promote shade-intolerant tree species, grasses and forbs, and several endemic plant species, thereby maintaining biological diversity. Maintaining and improving open canopy conditions that promote vigorous oaks would improve mast production in these forests, which is a very important food source for many species. Dusky-footed woodrats (*Neotoma fuscipes*), an important prey species for NSO, appeared in higher densities in areas with large (>33 cm dbh) black oaks in a mixed-conifer forest with few other sources of hard mast (Innes and others 2007). Owls forage within oak savannahs (in winter in lower elevations) and in manzanita shrub-fields in southern Oregon and northern California with low basal areas of conifer trees, presumably because they contain dusky-footed woodrats (Irwin and others 2012). Both conifer and hardwood mast appear to be a critical food for some owl prey species and "likely has a strong bottom-up trophic effect" [p. 6] (Dan L. Hansen and Dunk 2016). The authors further suggest opening the canopy and using fire to restore oak to benefit these species. This suggests proposed oak restoration treatments, would improve conditions for owls and their prey in multiple indirect ways. A diversity of tree species was also described as important to provide asynchronous mast production, thus providing continuity in food supply to prey species, so the value of restoring and preserving both oak and pine stands would go beyond just the amount of available of food, but also when it was available. Late-successional forests and NRF are not in shortage in this planning area (53%), so opportunities to develop quality foraging habitat and heterogeneity would benefit this LSR.

Desired Future Conditions

The desired future condition of the oak savannahs is a mostly open savannah with Oregon white oak, some canyon live oak, scattered ponderosa pine, and California black oak around the edges of openings. The understory vegetation would be dominated by grasses and forbs. The desired future condition is present in some areas within the planning area. These oak savannahs could be regularly maintained with low intensity fire, perpetuating the condition of an open oak savannah. Establishment of oak regeneration is important, especially in areas where conifer overtopping has resulted in oak mortality. Frequent treatments of prescribed fire would maintain this open savannah forest structure and promote the desired species composition.

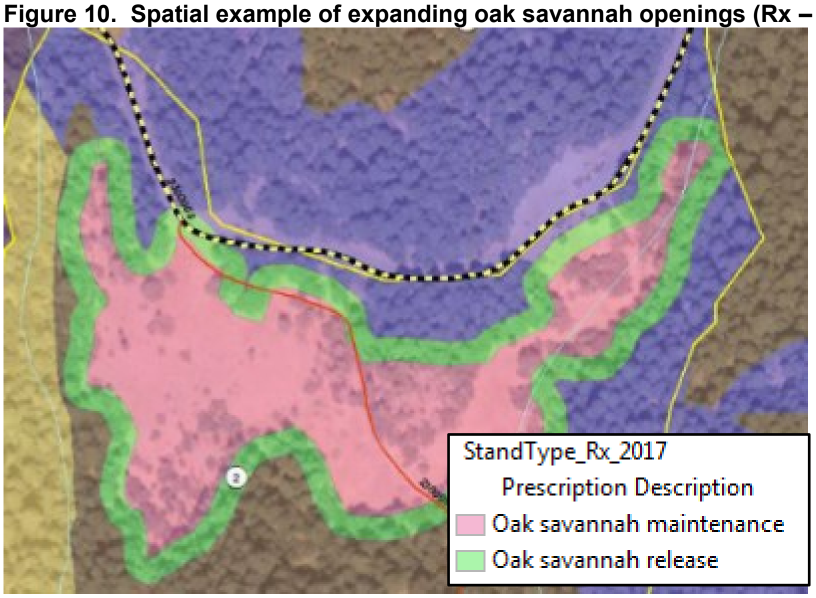
The desired future conditions of the oak woodland areas would look different than the more open oak savannahs. These areas would retain and promote growth of Douglas-fir and other species present in these mixed conifer-hardwood forests. Douglas-fir composition and overstory canopy cover would remain, although in lower densities to provide ample sunlight to the oaks in the midstory and to promote grass and forbs in the understory. Large Douglas-fir trees would be intermixed within California black oak and scattered Oregon white oaks and ponderosa pine. Oaks would be released, and new oak seedlings would regenerate and become a much larger component of the stand composition. Larger trees of common hardwood species would be maintained. Establishment of oak regeneration is important, especially in areas where conifer overtopping has resulted in oak mortality and transitioned areas away from oak woodlands. Oak mast production would increase, creating improved foraging habitat for deer, elk, bears, many bird species, and woodrats. This improved mast production would improve foraging habitat for NSO, by increasing an important food source for prey species such as the woodrat. Frequent treatments of prescribed fire would maintain this late open forest structure and promote the desired species composition. Large snags and down wood can be difficult to maintain over time with very frequent fire, but in areas these structures will emphasized or created with fire.

Oak restoration silviculture actions

Variable density treatments are proposed within oak stands including: expanding oak savannah openings, radial release around white oak, black oak and ponderosa pine, thinning to reduce stand density, skips, and planting. Primary target species to cut in order to reduce stand density include Douglas-fir and some understory tanoak and canyon live oak. Treatments would utilize commercial logging techniques, handsaw work, and prescribed fire to reduce stand densities

Expanding oak savannah openings would involve removing most Douglas-fir that have encroached the savannah, exist on the edge of open savannah areas, or around oaks. In application this is not much different than the oak radial release, but the result expands existing openings. While many of these savannahs would be very open, they would still have scattered canopy cover of oaks. For an example of how this would look spatially, see Figure 10.

Figure 10. Spatial example of expanding oak savannah openings (Rx – oak savannah release)



This is an example of oak savannah release in stand #2. The concept is to remove Douglas-fir that are competing with the oaks around the edges of the savannah. This example displays a 50 foot buffer/release around the oak savannah.

Variable density thinning is aimed at creating a clumpy distribution of trees, with reductions in canopy cover to promote a late-open forest structure with opportunities for development of oaks. Part of what creates the variable density is the radial release cutting of most conifers or lower priority hardwoods within 35-60 feet of oaks and pines suitable for release from competing trees. For a visual of what oak release might look like, see Figure 10. In density reduction treatment areas where there are no oaks, cutting diameter limit would be 26 inches DBH. When releasing oaks, diameter limit would be 28 inches DBH. Target canopy covers ranges from 0-20% in open oak savannahs, 20-40% in oak woodlands with high oak composition, 40-60% in oak woodlands with lower oak composition, and >60% in some areas with few oaks. Cutting of small trees and brush in the midstory and understory will occur throughout much of the treatment area. Some fuels piling or other fuels treatments may be required in some areas prior to the prescribed fire.

Riparian reserves are defined as areas within 175 feet of stream or within 350 feet of a fish bearing stream. Areas within close proximity (primary shade zone) to intermittent and perennial streams will not have any harvest removal. Some thinning and fuel reduction would occur, but trees will be felled and left. This thinning and cutting would occur to promote desired species, reduce density to encourage large tree development, and to reduce fuels so that desired fire effects are achieved during prescribed fire. Areas further upland, outside the primary shade zone, will be treated and maintain higher canopy cover than upland areas.

Skips would occur throughout the treatment areas where there are few oaks, in riparian areas close to streams, and in areas for resource protection. Skips would occur on 10-20% of the treatment area. These areas may not be totally skipped, as some hand-cutting may be deemed necessary in skips to ensure the desired fire effects are achieved during prescribed fire.

If snag levels are low following cutting and fire treatments, snags and large down wood would be created in identified restoration units using a variety of methods: girdling, topping and de-limbing, and inoculation. Created snags would be distributed as individuals or clumps across all treatment types (thinned, skips, gaps).

Figure 11. Photo examples of radial release around a California black oak (project in Illinois Valley)

Planting of Oregon white oak and California black oak would help re-establish these species where they have already been extirpated, where composition of oaks has been greatly reduced, and to promote regeneration where little is occurring naturally. Seeding of native grasses, pollinator species, and planting of native shrubs will also occur.

Oak treatments vary by alternative in both prescription cutting intensity and in scale. The maximum tree size to cut and removed (harvested) varies from 28 inches DBH in Alternative 1 to

20 inches DBH in Alternative 3. See Table 11 for comparison of oak prescriptions between alternatives.

Table 11. Oak silviculture treatment comparison

Treatment parameter	Alternative 1 (proposed action)	Alternative 2	Alternative 3
Largest tree cut for radial release of oaks or pines (DBH)	28”	28”	20”
Largest tree cut for thinning areas (DBH)	26”	26”	20”
Estimated number trees >20 inches cut (from FVS model runs)	15,000 trees	15,000 trees	0 trees
Oldest tree cut (years)	140 years	140 years	140 years
Canopy cover reduced below 40% in white oak savannah (acres)[1]	197 acres	197 acres	100 acres
Canopy cover reduced below 40% in black oak woodland (acres)[1]	226 acres	0 acres	0 acres
Mapped riparian areas treated (acres)	476	476	247

[1]Reduction of existing canopy cover to below 40% will result in removal of northern spotted owl dispersal habitat.

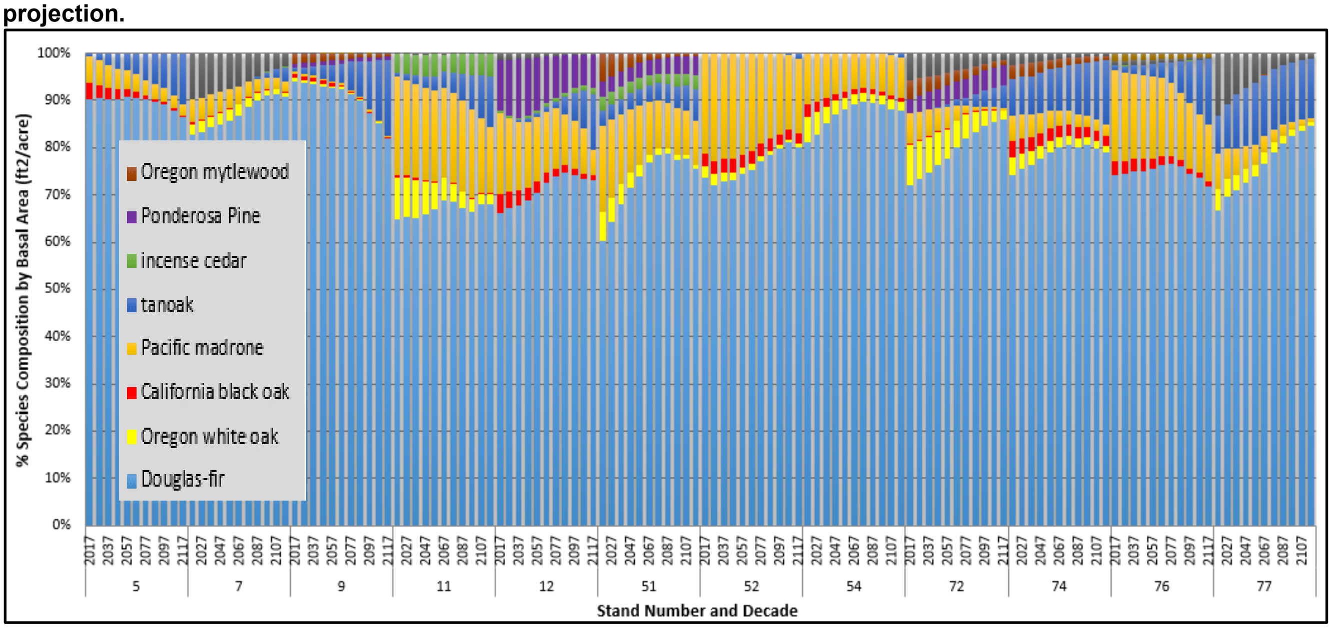
Table 12. Oak silviculture prescription comparison by acres

Prescription	Prescription - Description	Alt. 1 acres	Alt. 2 acres	Alt. 3 acres
Oak savannah maintenance	Non-commercial cutting, prescribed fire	217	217	154
Oak savannah restoration	Cut and remove majority of overstory conifers, CC 0-20%, prescribed fire	281	281	166
Oak savannah release	Cut and remove conifers within 50' of oak savannah, CC 20-40%, prescribed fire	141	141	88
Oak woodland release	Radial release of oaks, reducing CC to 20-40%, prescribed fire	228	0	0
Oak woodland thinning	Some radial release, moderate to heavy thinning, CC of 40-60%, prescribed fire	853	1081	596
Oak woodland light thin	Limited radial release, thinning smaller trees, CC>60% , prescribed fire	411	411	112
Pine release/thin/large gaps	Radial release of pines, moderate to heavy thin, gaps up to 3/4 acre CC 40-60%, prescribed fire	5	5	5
Rx fire	Only cut small material required to achieve desired results in Rx burn, in some places no cutting will be required, prescribed fire	781	781	26
Totals		**2917**	**2917**	**1147**

No Action

With the no-action prescription scenario, the candidate stands would continue on the current stand development trajectory. In some of the white oak savannahs, moisture limiting soil conditions may continue to lead to Douglas-fir mortality, likely resulting in some self-maintenance of oak savannah conditions over time. In other areas with better soils for growing Douglas-fir and tanoak, the continued shading of the white and black oak are projected to lead to lower composition of these species over time. Forest Vegetation Simulator (FVS) was used to simulate the no action prescription. Figure 12, shows the modeled trend of species composition for many stands over a 100 year projection cycle. The model confirms observations that these stands will continue to trend towards more Douglas-fir and tanoak, and with less white and black oak composition over time.

Figure 12. No Action - Tree species composition (basal area, ft2/acre) over 100 year modeling projection.



The vertical (Y) axis is the % of species composition by basal area (ft2/acre). The horizontal axis has each stand number and above that the decade of the model simulation. Oregon white oak is displayed in yellow and California black oak is displayed by red. This graph includes representative oak stands.

What if we cut no trees over 80 years?

Since the majority of the oak stands are within LSR, consideration was given to a prescription alternative that would only cut trees less than 80 years old and less than 20 inches in diameter. In Alternative 1, 2019 acres of the 2199 acres identified for oak treatment have overstory Douglas-fir that are greater than 80 years old. The 80 year restriction is more limiting than the 20 inch diameter limitation. The 20 inch diameter limitation will be compared further below.

Oak woodlands and oak savannahs that are currently in the establishment or piercing stage of conifer encroachment (see Figure 4) would have some opportunities for treatment with the 80 year age limitation. Cutting younger conifers and maintenance treatments could occur under this treatment prescription, which would allow for maintenance of the white oak savannahs where Douglas-fir has struggled to establish and survive due to poor soils. Around edges of these savannahs, and in oak woodlands where the oaks have already been overtopped, treatments would have little effect on achieving the desired future conditions. Almost all of the overstory trees composing the majority of the canopy are over 80 years of age. Without cutting these trees to provide more sunlight to oaks and understory vegetation, shade intolerant oaks will continue to succumb to competition from the dense overstory of conifers.

Under these under 80 year old prescription limitations, treatments would be entirely non-commercial due to small tree sizes and low densities of trees in these size classes. Some degree of meaningful treatment (actually release or maintain oaks) would potentially be possible in up to 590 acres under this prescription. Approximately 440 acres would be described (prescriptions defined above in Table 12) as oak savannah maintenance and oak savannah restoration and approximately 150 acres would described as oak woodland release and oak woodland thinning.

This prescription alternative was considered, but not carried forward as an alternative due to its limited scope and limited ability to meet the purpose and need to maintain ecosystem diversity and improve resilience via a reduction in overstory canopy in the mixed oak woodlands that currently have the highest need for restoration treatments.

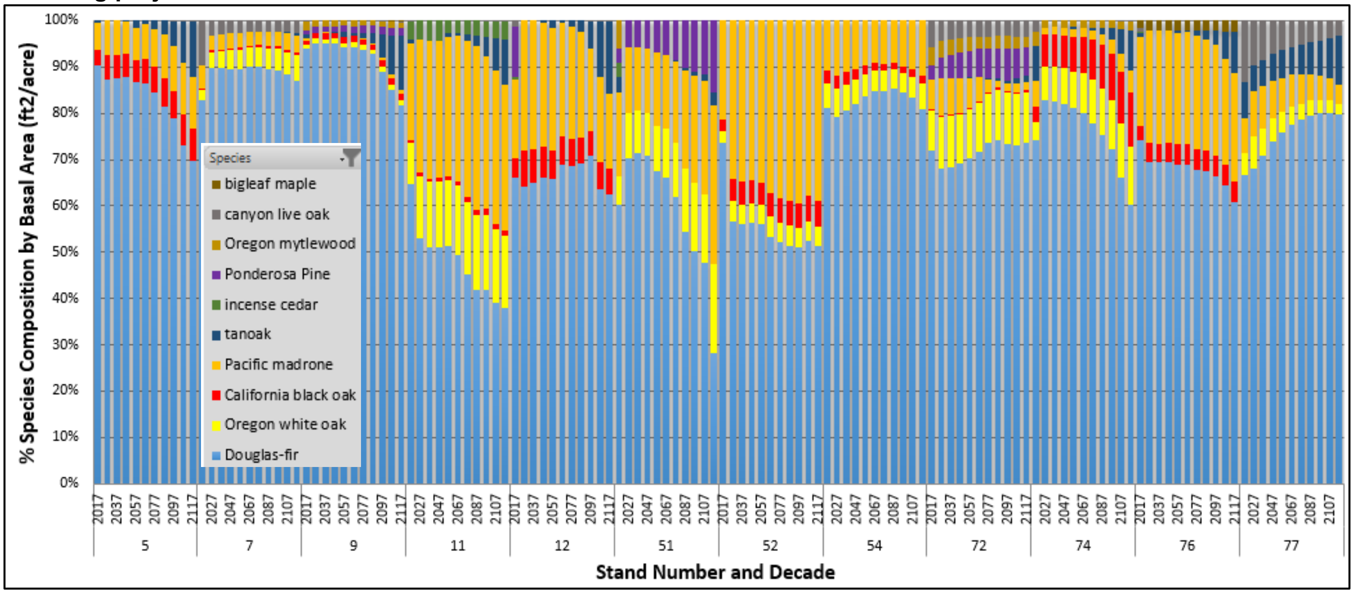
What if we only cut trees up to 20 inches DBH?

Limiting the largest tree to cut to 20 inches and not reducing canopy covers below 40% was considered because the project is largely in LSR. Retaining larger live trees is an important part of the management strategy for achieving the structural components of a late-seral forests. Large live trees eventually become large standing dead wood, down dead wood, or large wood within streams. However to preserve important unique habitats that deviate from a closed-canopy, conifer-dominated forest structure typical of spotted owl nesting and roosting habitat, this <20" alternative compromises the ability to fully release oaks. In the proposed action, legacy trees and trees over 26-28" would be retained as described in LSR objectives, and these unique habitat types would be restored to its former, historically open canopy structure.

Cutting trees less than 20" DBH can achieve partial release of encroached oak savannahs and oak woodlands. The degree of release is variable on a case by case basis. In some circumstances the 40% canopy cover would limit the amount of release on oaks. In other cases, limiting cutting diameters to 20" would limit release of oaks. This would reduce the composition of oaks in these stand over the long term when compared to proposed action (cuts trees greater than 20").

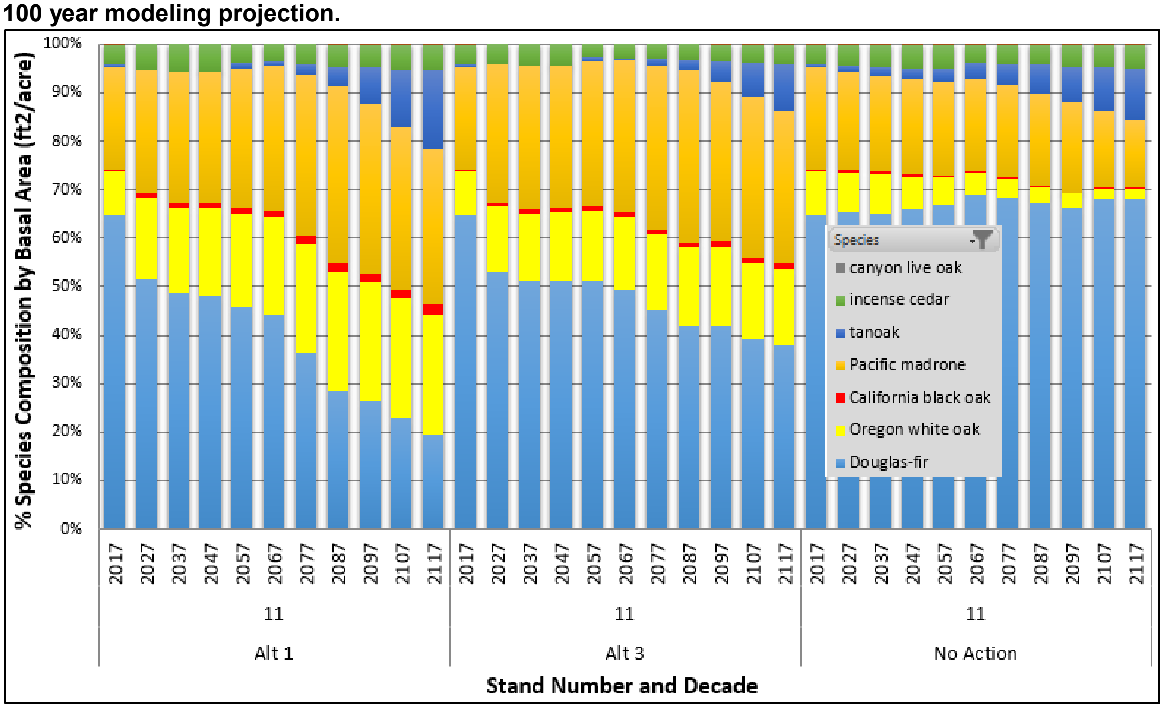
Figure 13 shows the FVS projections for basal area composition of oaks by stand over a 100 year period. Figure 14 contrasts the different prescription alternatives in an example of an individual stand with modeled species compositions shown over a 100 year period. In stand #11, this FVS modeling scenario shows white oak and black oak composition of up to 25% of total stand basal area in Alternative 1, while it can only sustain about 15% of stand basal area in oaks in Alternative 3 (<20" DBH). While limiting cut tree size to 20 inches DBH certainly improves the conditions for oaks compared to no action, it does not sustain oak composition nearly as well as Alternative 1 (>20" DBH limit). A ten year study of Oregon white oak release found that response of oaks to half-release treatments were small, the growth response was not significant, and it is unclear for how long the acorn production will persist (Devine and Harrington 2013). There are not studies that have examined this in California black oak, but observational evidence of these trees in full sunlight suggests the effects would be similar. Mature black oaks are one of the least tolerant trees to shading within the mixed-conifer forest, although very young trees may be more tolerant than pines (Bigelow and others 2011).

Figure 13. Only cut trees < 20" DBH - Tree species composition (basal area, ft2/acre) over 100 year modeling projection.



The vertical (Y) axis is the % of species composition by basal area (ft2/acre). The horizontal axis has each stand number and above that the decade of the model simulation. Oregon white oak is displayed in yellow and California black oak is displayed by red. This graph includes representative stands where there were few open white oak savannahs.

Figure 14. Alternative Comparison – Stand #11 - Tree species composition (basal area, ft2/acre) over 100 year modeling projection.



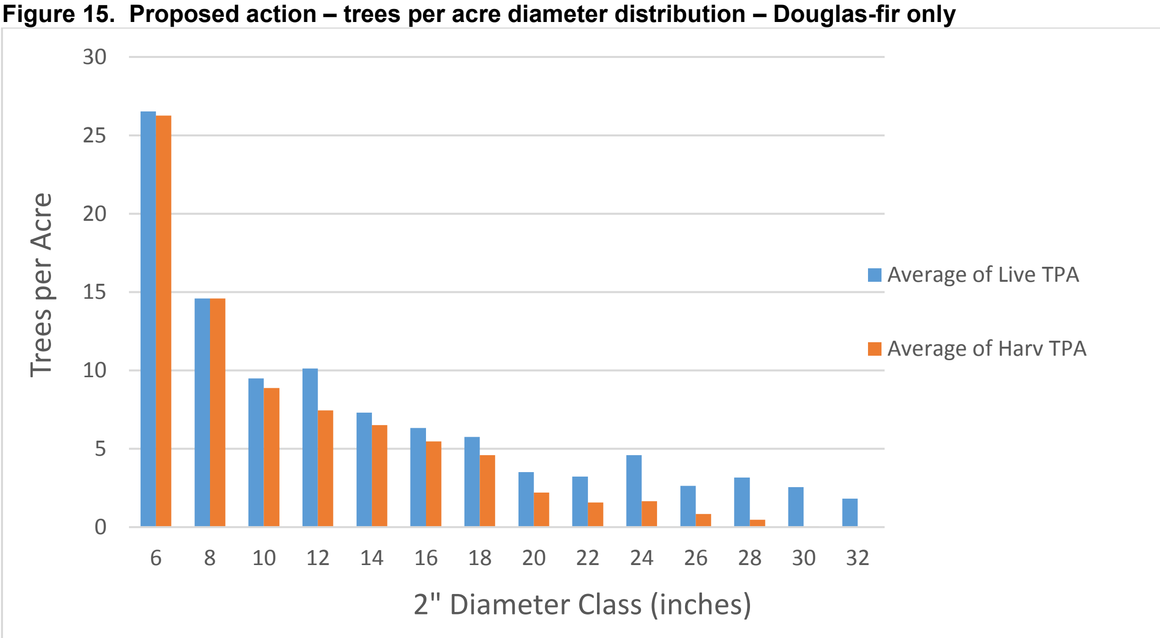
The vertical (Y) axis is the % of species composition by basal area (ft2/acre). The horizontal axis has each stand number and above that the decade of the model simulation. Oregon white oak is displayed in yellow and California black oak is displayed by red. This graph includes stand #11, where open white oak savannahs composition is relatively high.

Cutting of 20-28 inch trees will also allow for more ability to reduce canopy cover to levels that can support oak regeneration and get enough sunlight to the forest floor to sustain the important plant communities associated with these oak systems. Not cutting greater than trees 20" limits the ability to reduce some stands overstory canopy and some portions of stands, which is especially important if oaks are present or regeneration of oaks is desired.

Proposed Action

The proposed action is the preferred prescription to achieve the purpose and need of oak savannah and oak woodland restoration. Cutting trees larger than 20 inches DBH and older than 80 years old allows for reduction of the overstory canopy cover of Douglas-fir and releasing of oaks from competition. A 10-year study of Oregon white oak (Devine and Harrington 2013) found that removing all conifers around oaks within one tree height ("full-release" treatments) significantly increased oak growth and acorn production compared with non-targeted thinning in encroached stands. While the prescription in this project will not remove all Douglas-fir trees within a tree height radius from oaks, it would far more Douglas-fir trees from around oaks than if a 20 inch diameter limit existed. Fewer studies have examined the effects of release treatments around black oak. Mature black oaks are one of the least tolerant trees to shading within the mixed-conifer forest, although very young trees may be more tolerant than pines (Bigelow and others 2011). While both oak species have higher proportions of mortality in closed-canopy conditions, the lower proportion of California black oak mortality in closed-canopy stands suggests a higher tolerance of low-light conditions than Oregon white oak (Schriver and Sherriff 2015).

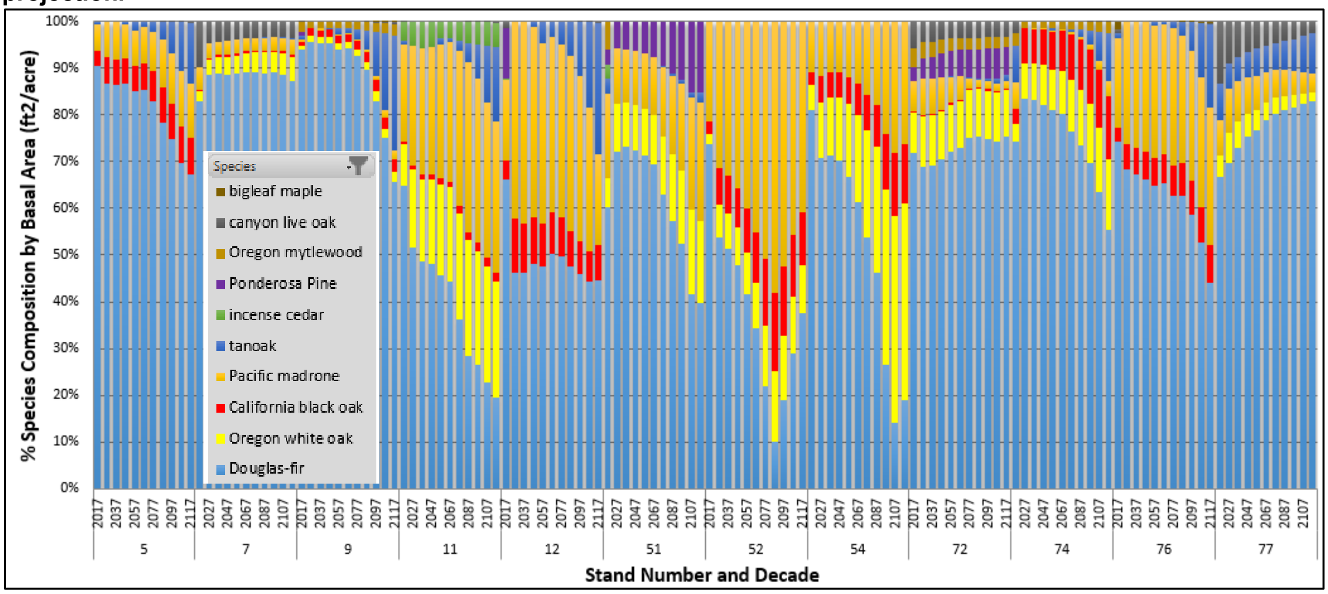
Figure 15. Proposed action – trees per acre diameter distribution – Douglas-fir only



The vertical (Y) axis is the Douglas-fir trees per acre average across all the oak stands. The horizontal axis is the two inch diameter class. Current live trees are displayed in blue and estimated harvest trees are in orange. Harvest trees per acre is estimated from a general prescription applied across all oak stands.

Since the Douglas-fir in these stands are well established and older, larger trees exist in some areas. In order to maintain composition and vigor of oaks on these sites maintaining prescription flexibility to cut larger trees that are shading oaks is key to achieving meaningful release. This is especially true with the shade intolerant white oaks. Flexibility to cut larger trees is still important for releasing black oak as well, but higher canopy cover levels can be retained and still sustain black oak. FVS modeling was used to estimate how many trees over 20 inches DBH may be cut. This simulation is a general prescription that harvested stands to an average of 40% canopy cover in oak woodlands. A diameter distribution table can display an estimate on how many Douglas-fir would be cut in each diameter class. A summary, showing the average from all of the sampled stands can be seen in Figure 15. In Alternative 1 and 2, an estimated average of 7 Douglas-fir trees per acre over 20 inches would be harvested, totaling about 15,000 trees within all of the oak stands combine. Averaged across the oak stands, this harvest simulation harvested 7 of the 27 (25%) trees per acre larger than 20 inches. The range across the treatments stands of trees over 20 inches project to be cut was from zero to 30 trees per acre.

Figure 16. Proposed Action - Tree species composition (basal area, ft2/acre) over 100 year modeling projection.



The vertical (Y) axis is the % of species composition by basal area (ft2/acre). The horizontal axis has each stand number and above that the decade of the model simulation. Oregon white oak is displayed in yellow and California black oak is displayed by red. This graph includes representative oak stands.

In order to achieve the desired release treatments described above, the prescription proposes reducing canopy cover below 40% around white oak and black oak in some areas. Areas adjacent areas to open oak savannahs or that have a higher composition of white oak present are proposed to be reduced below 40% canopy cover. 197 acres of forest with canopy cover currently greater than 40% is proposed to be reduced below 40% around white oak. These areas around white oak are not likely to achieve NRF habitat, and many Douglas-fir have died in these areas already due to droughty soils. Areas with high composition of larger black oak are proposed to be reduced below 40% canopy cover to release these oaks that are present in unusual abundance in these areas. These areas total 226 acres in proposed action. This reduction of dispersal habitat for the NSO represents 0.5% of the planning area and 0.2% of the Fishhook LSR.

Post Treatment Conditions

Following treatments the oak treatment stands would be much more open stands with high heterogeneity in canopy cover and forest structure. The largest (26-35+" DBH) Douglas-fir trees would remain, providing variable levels of canopy cover (see Table 13). The treatment areas would be a patchwork of oak savannah, oak woodland, open canopy mixed conifer-oak woodland, and closed canopy mixed conifer/hardwood stands.

White oak savannahs would have very few, large Douglas-fir remaining. Large Douglas-fir snags would exist around edges, especially within riparian's and closer to streams. Oaks would have open grown conditions with little to no shading from Douglas-fir. Herbaceous forbs and grassy vegetation would be the dominant ground cover vegetation. Fuels conditions would be suitable for frequent prescribed fire, maintaining this oak savannah condition.

Oak woodlands would have much few Douglas-fir but still retain 15-50 Douglas-fir per acre. Black oak and white oak would have 30-50 feet of clearing around these trees, with some large Douglas-fir remaining adjacent to oaks (26-45+"). The Douglas-fir overstory would generally be much more open with a mixed hardwood stand composing of the midstory, including black and white oak, Pacific madrone, canyon live oaks, and some tanoak. Residual Douglas-fir would be very clumpy, with very open areas around oaks and clumps of Douglas-fir where there are less oaks. Scattered ponderosa pine would have 30-50 foot clearing around these trees. Some areas where no oaks are currently present would have an open canopy Douglas-fir overstory, with planted black and white oak, mixed hardwoods, and an herbaceous ground cover. Other areas where no oaks are currently present would remain in currently closed canopy condition as skips. These skip areas would be focused on areas without oaks, within riparian reserves, in NSO NRF habitat, and in areas currently developing towards a late-seral condition. Snags would be present throughout treatment units, but focused within riparian areas, where felling would damage oaks, and in skips.

When interpreting data in Table 13, stands that are listed as oak woodland and oak savannah, it is important to consider these metrics as an average, with the range of post-harvest conditions being much wider. These stands are highly dissected by riparian areas, oak savannahs, oak woodlands, and high variable conditions. Basal Area, relative density, trees per acre, and canopy cover calculations are averaged across identified units, which become less meaningful when conditions are so variable. Metrics like Quadratic Mean Diameter (QMD) that average among measured trees are not as affected by this variability as other measurements that are expanded and averaged on a per acre basis.

Table 13 displays estimates from FVS model simulations that are relatively simple compared to the actual prescriptions. These figures provide an estimate of post-harvest conditions in stand averages, recognizing that residual stand conditions will be highly variable. Target canopy covers are from on the ground assessments and spatial data that identified forest types, oak composition, current forest structure, and NSO habitat conditions. These target canopy covers were designed with all of these in mind and are spatial identified in the project GIS. The weighted average canopy cover is based on the area (% of stand acreage) treated to that intensity. Stands with more oak savannah (3, 6, 7, 11, 12, 51, 53, 72, and 77) end up with lower weighted averages. In these stands, there are currently and would be more areas with canopy covers below 40% (% stand 0-20 CC and % stand 20-40 CC). Some areas of dispersal will be downgraded (~500 acres). Other areas would be maintain above 40% in current dispersal and foraging habitat, and other areas would be retain above 60% in NRF.

Effectiveness measures for post treatment include: stand composition - higher percentage of oaks (% compositions measured by trees per acre, canopy cover, or basal area), lower stand density (measured by stand density index), successful regeneration of oaks (% survival following planting or natural regeneration), reduction in risk of stand replacement fire (flame-length, fireline intensity), and conditions in which low intensity fires can be applied regularly.

Table 13. Oak stands – estimated post-harvest stand metrics from FVS

Stand #	Stand Type	Total TPA > 7 inches DBH	QMD trees >7" DBH (inches)	Basal Area ft2 /acre	Relative Density	% stand[1] 0-20% CC	% stand 20-40% CC	% stand 40-60% CC	% stand >60% CC	% stand in skips	Weight Avg CC
1	Oak woodland	40	25	240	52	0	14	30	0	56	60
2	Oak savannah and woodland	49	20	100	26	18	17	32	7	26	43
3	Oak savannah and woodland	56	20	120	31	27	44	15	4	10	29
5	Oak woodland	36	25	120	26	0	32	32	23	13	45
6	Oak savannah and woodland	35	16	80	28	32	12	40	0	16	33
7	Oak savannah and woodland	43	22	100	28	17	28	42	0	13	35
9	Oak woodland	30	28	140	26	24	0	50	14	12	44
11	Oak savannah and woodland	42	26	150	33	13	15	61	0	11	38
12	Oak savannah and woodland	22	28	140	27	36	27	23	0	14	29
51	Oak savannah and woodland	57	20	120	27	19	24	35	11	11	36
52	Oak woodland	24	34	140	26	0	14	25	50	11	52
53	Oak savannah and woodland	49	21	120	26	36	10	46	0	8	29
54	Oak woodland	54	21	140	37	0	26	59	0	15	42
72	Oak savannah and woodland	67	17	100	28	41	26	23	0	10	27
73	Oak woodland	40	26	140	25	10	2	9	66	13	55
74	Oak woodland	47	24	150	33	30	0	5	52	13	46
76	Oak woodland	31	31	160	29	9	0	33	42	16	52
77	Oak savannah and woodland	86	13	80	23	35	15	41	0	9	29
78	Oak woodland	31	29	150	27	3	4	56	19	18	49
Averages		**44**	**24**	**131**	**29**	**18**	**16**	**35**	**15**	**16**	**41**

Abbreviations: TPA (Trees per Acre), QMD (Quadratic Mean Diameter measured at breast height), CC (Canopy Cover), and Weight Avg CC (Weighted average canopy cover of stands posted treatment). 1Percent of stand canopy cover numbers show the % of the area in the stand that would have a canopy cover in that range. Some treatment areas already have canopy covers between 0-40% and others will be reduced below 40% canopy cover (resulting in removal of NSO dispersal habitat).

Sugar pine stands

Sugar pine stands development

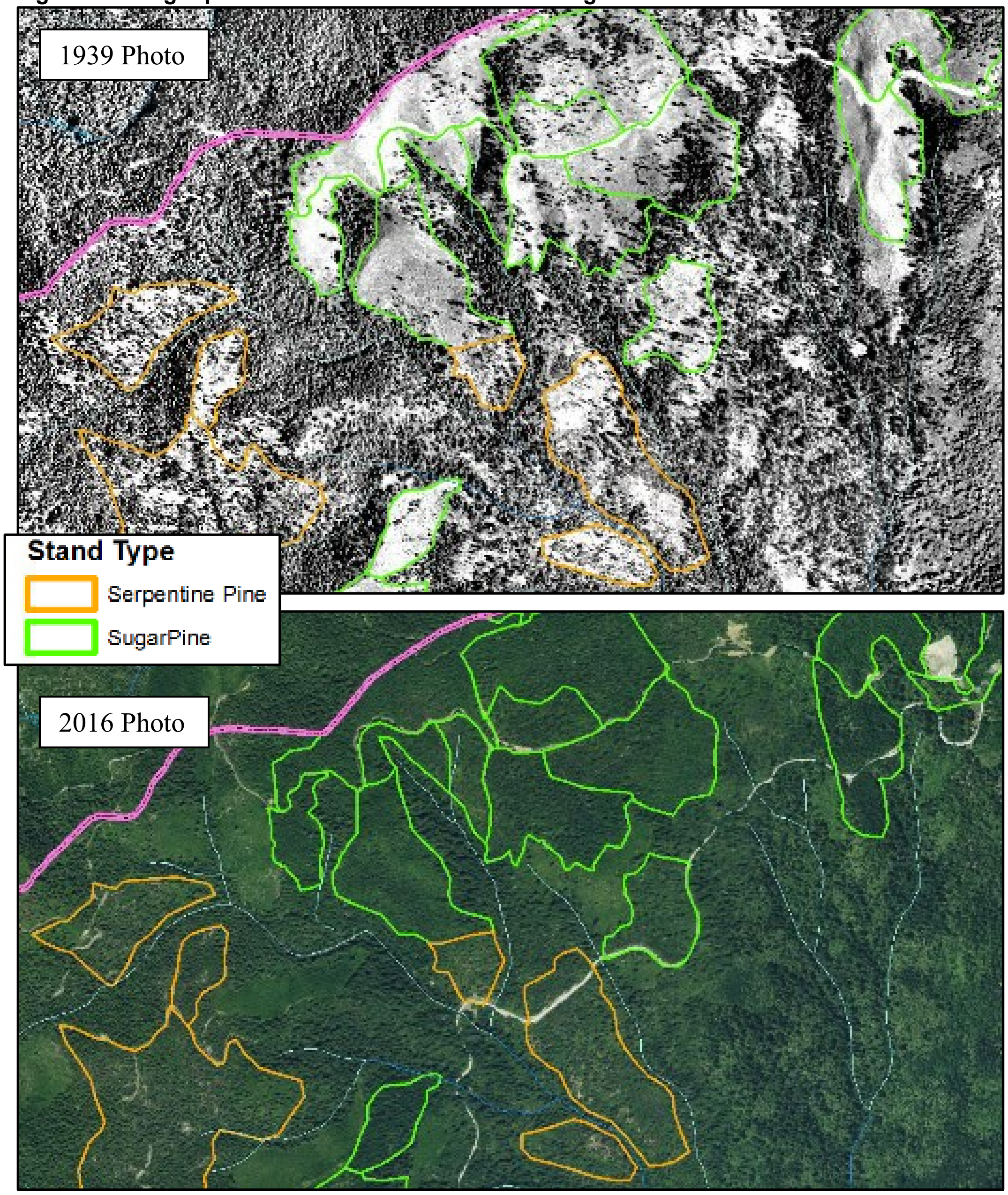
These stands are naturally regenerated stands that established after fires from 1900-1930s. Following the fires, these stands naturally regenerated with sugar pine (*Pinus lambertiana*), knobcone pine (*Pinus attenuata*), Douglas-fir (*Psuedotsuga menziesii*), giant chinquapin (*Chrysolepis chrysophylla*), western white pine (*Pinus monticola*), Jeffrey pine (*Pinus jeffreyi*), and other species. Large sugar pines that survived the fires have grown in open conditions for 70+ years, resulting large open grown tree form.

In Southwest Oregon as elsewhere in the West, evidence is accumulating that sugar pine and western white pine are being threatened by the combination of white pine blister rust, a disease caused by an introduced pathogen, infestation by mountain pine beetle, a density dependent bark beetle species, and substantial increases in forest stocking associated with fire exclusion (Conklin and others 2009) (Harvey and others 2008) (Samman and others 2003) (van Mantgem and others 2004). These sugar pine stands are no different, as there is evidence that sugar pine composition within these stands and across the landscape is decreasing. Comparison of 1939 aerial photos to modern photos shows very stark contrasts in forest structure, especially with stands identified for sugar pine emphasis and serpentine areas. This change in forest structure is not favorable to maintaining higher compositions of sugar pine within this landscape, as sugar pine mortality appears to be much higher in high density stands. Release treatments around sugar pine in a 9-year study in Southwest Oregon (Goheen, 2011) showed that treatments increased growth, decreased tree mortality, and increased sugar pine regeneration. Ultimately, suppression of fire has reduced stand resilience and led to pine being outcompeted by Douglas fir. These stand conditions also have led to a stunting of developmental features and canopy structures that are desirable characteristic of late successional forest structures in these forest types.

As these stands have developed in the absence of disturbance, uniform, dense stand conditions are common as these stands develop through the stem-exclusion stage. These stands are considered to be in the stem exclusion stage (Oliver and Larson 1996). Dominant stand development processes are: (1) development of woody biomass; (2) competitive exclusion of many organisms; (3) density-dependent tree mortality or self-thinning; (4) natural pruning of lower tree branches; and (5) crown-class differentiation (Franklin and others 2002). Intense inter-tree competition occurs in dense stands resulting in significant density-dependent mortality, primarily of trees at the low end of stand diameter distributions (Franklin and others 2002). This competition results in lowering live-crown ratios and decreasing annual growth increments. Without thinning, the stand structure and processes could persist and pass through an extended stem exclusion stage (Oliver and Larson 1996) resulting in mortality of smaller overstory trees and suppression of most understory regeneration and shrub communities.

White pine blister rust has been a contributing factor for mortality of large overstory and seedlings/saplings of sugar pine and western white pine in the planning area. Some of the first signs of white pine blister rust in Oregon was documented 1926 in the Panther Mountain area, which is about 6 miles to the west of the pine stands in the northwestern portion of the planning area (Goheen,). Mortality of the 5 needle pines has been occurring for some time in the planning area, and continues within these stands. An assessment of 5 needle pine mortality in southwest Oregon concluded that mortality was higher in these species than any other tree species encountered in surveyed stands (Goheen and Goheen 2014). Especially ominous was the observation that substantial mortality is occurring in five-needle pines size classes from saplings to large trees. On a percentage basis, there was 2.5 times as much mortality of sugar pines as there was of other tree species in the same stands and 3.2 times as much mortality of western white pines as other species (Goheen and Goheen 2014). An initial assessment by Ellen Goheen (USFS - Southwest Oregon – Forest pathologist) in the field, concluded that white pine blister rust was likely a contributing factor to most of the mortality of large overstory sugar pines and western white pine in the planning area. There is common top-kill in large live pines, likely a result of the pathogen as well. Bole cankers were also observed in young regeneration and saplings, which have a high potential to girdle host stems. While mountain pine beetles have been recently a major contributor to pine mortality in southwest Oregon, they have not been observed to be a major factor in this planning area.

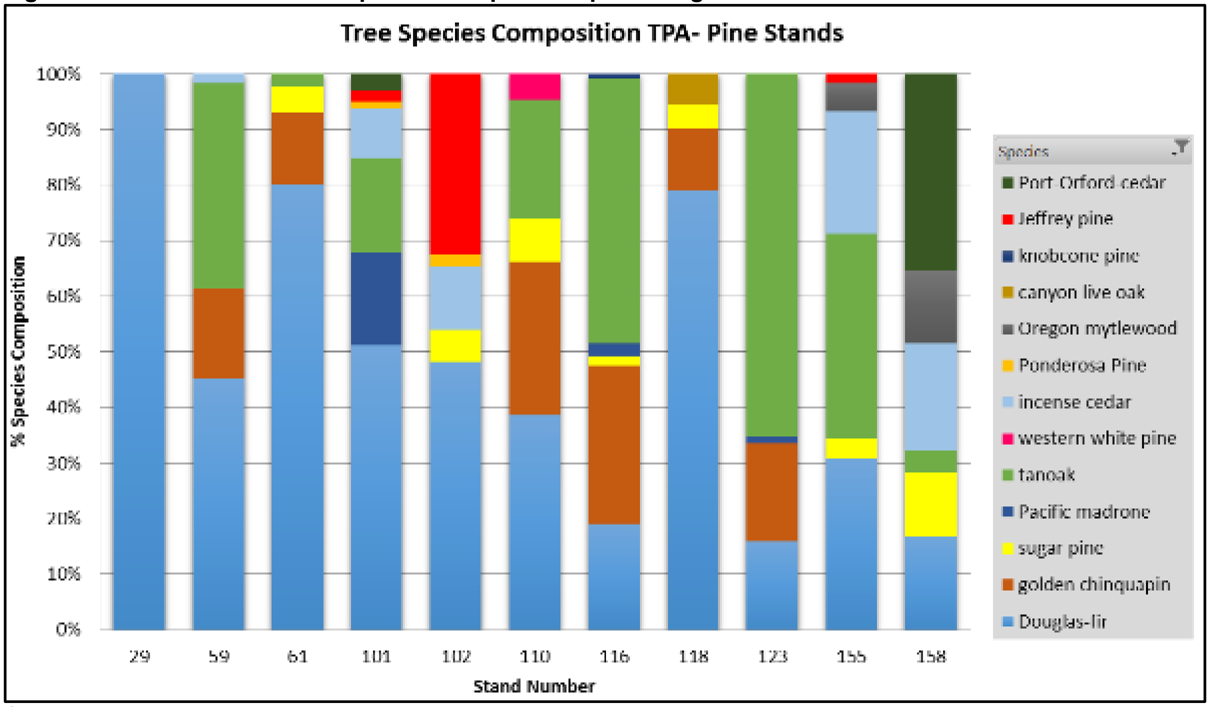
Figure 17. Sugar pine stands 1939 vs 2016 aerial images



Sugar pine and Serpentine pine stands composition

Stands that are designated as pine stands either currently have sugar pine, western white pine, or Jeffrey pine present in the stands. The composition of pine in some portions of these stands is low and is likely much lower across the whole area due to competition based mortality and mortality from white pine blister rust. Many of the stands described as sugar pine stands contain sugar pine as minor species. Some of the sugar pine stands and many of the serpentine stands actually have a pretty high composition of pines, especially when using basal area instead of trees per acre for composition.

Figure 18. Pine Stands - Tree species composition percentage



Graph displays tree species composition percentage, using trees per acre. This only shows trees > 7 inches DBH. Stands 102, 155 and 158 are considered serpentine pine stands.

Species commonly found in the pine stands in order of relative abundance (TPA) include: Douglas-fir (*Psuedotsuga menziesii),* giant chinquapin (*Chrysolepis chrysophylla*), tanoak (*Notholithocarpus densiflorus*), incense cedar (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*), Jeffrey pine (*Pinus jeffreyi*), knobcone pine (*Pinus attenuata*), western white pine (*Pinus monticola*), and other species.

Table 14. Pine stands - plant series and plant associations[1]

Plant Series	Plant Association	Environment	Species richness (Avg # species)
Tanoak	Tanoak – western white pine / huckleberry oak / common beargrass	wet - warm	30
Tanoak	Tanoak – golden chinquapin – sugar pine	wet - cool	14
Douglas-fir	Douglas-fir / huckleberry oak – pinemat manzanita / common beargrass	wet -warm	57
Douglas-fir	Douglas-fir – incense cedar – Jeffrey pine	dry - cool	31
Jeffrey pine	Jeffrey pine / huckleberry oak – pinemat manzanita	wet - warm	49
Jeffrey pine	Jeffrey pine– incense cedar – Douglas-fir	dry - warm	21

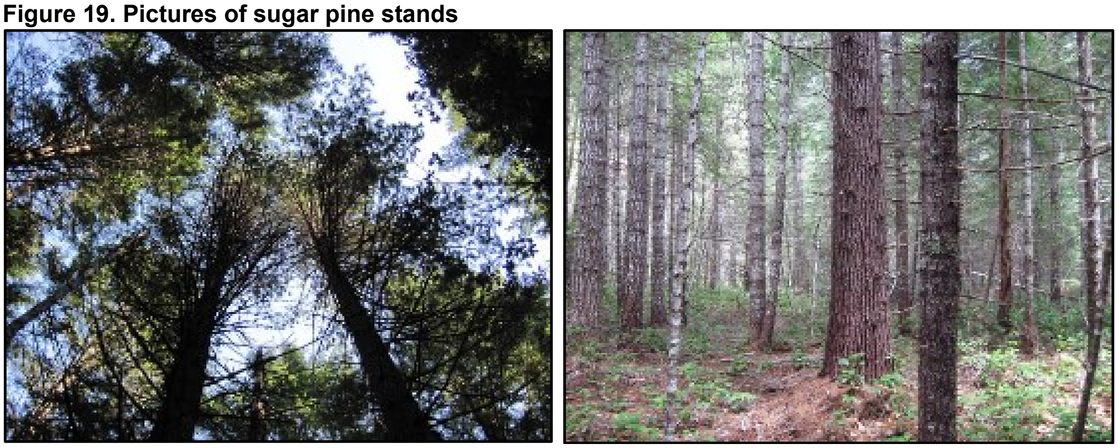
[1]Data from the Field Guide to Forested Plant Associations of Southwestern Oregon (USDA, 1996). Information is based on averages for the plant association, and does not necessarily represent site-specific characteristics

The stands are located in three different plant series, including the Jeffrey pine series, the Douglas-fir series, and the tanoak series (Atzet and others 1996). These three species are the climax species for each series, meaning if the site were to grow, disturbance-free for centuries, this species would likely dominate the overstory vegetation. Within these three series, there are several plant associations. These are identified by unit in Table 14 below.

Sugar pine stands structure

Without disturbance, the resulting stand structure in many stands lacks structural complexity and has high stand densities. The growth of this regeneration has largely stagnated after closed canopy conditions were reached. Some stands consist of a single cohort, which regenerated between 1930 and 1960s. Other stands have this same age cohort, but also have an older cohort of mostly sugar pine and Douglas-fir that survived fires in the early part of the 20th century. Some regeneration of pine species is occurring, but growth into the mid-story or overstory is very limited. Competition from Douglas-fir and hardwood species are resulting in crown recession and decreased vigor in the pines. This decreased vigor makes the pines less resilient and vigorous, leaving them vulnerable to disturbance agents that can contribute to tree mortality. White pine blister rust has been causing mortality in the 5 needle pines for some time, and has had an effect on the stand structure and composition of these forests. Other sugar pine stands with more serpentine influenced soils are growing in lower stand densities, with some sugar pines growing in a relatively low competition environment.

Figure 19. Pictures of sugar pine stands



Left photo – two sugar pine with receding crowns due to Douglas-fir competition (Stand 123). Right photo – sugar pine (center) surrounded by 60-70 year old Douglas-fir cohort (Stand 113).

The mixed sugar pine forest type has variability due to changes in soils and heavy composition of hardwoods. Canopy cover ranges from 61% to 74% with Douglas-fir constituting the majority of the canopy cover. The majority of areas within stands consist of a single canopy layers, with a Douglas-fir, tanoak, sugar pine, and giant chinquapin constituting the overstory. The heights of the co-dominant cohort average 103 feet with a range of 83 to 122 feet. Some Douglas-fir and sugar pine regeneration has established in some areas, but the mostly closed canopy conditions inhibit growth. Also, white pine blister rust is reducing the recruitment of sugar pine regeneration into the overstory. There are some larger legacy trees present within these stands, and they are mostly sugar pine with some Douglas-fir. This older cohort is patchy and very scattered, except in stand #110, which has numerous, large sugar pine.

The quadratic mean diameter (QMD) for treatment stands ranges from 13 to 24 inches. The stand with a QMD of 24 inches has very low stocking of Douglas-fir, resulting in large, open-grown trees. The average QMD for these stands is 15 inches for all trees and 17 inches when just measuring Douglas-fir. All QMD calculations only considered trees larger than 7 inches diameter at breast height (DBH).

Stand density index (SDI) values range from 360 to 532 with an average of 448. This results in a relative density range of 51% to 76% (given a maximum SDI value ranges of 650-700). These higher values of relative density indicate that the stand is growing in a high-competition environment, resulting in lowering of live crown ratios, slowing of diameter growth, and some competition induced mortality. Relative density values above 55% indicate intense stand competition is occurring. Such stands will potentially remain in a stem-exclusion stage (Oliver and Larson 1996) for extended periods, perhaps a century or longer (Andrews and others 2005), before mortality agents begin to create canopy gaps suitable for recruitment of understory vegetation and development of large crowns in overstory trees (Franklin and Van Pelt 2004). Relative densities levels above 50% will certainly continue to contribute to the decline of sugar pine vigor, resulting in continued mortality. The basal area (feet^2/acre) ranges from 160 to 340 ft^2 /acre of basal area with an average of 232 ft^2/acre. This variation is mostly due to site quality and composition of hardwoods.

Table 15. Current conditions – stand averages from sampled pine stands

Unit Number	Stand	Stand Avg Age	Total TPA	Basal Area ft^2 /acre	SDI - Stand Desnsity Index	Relative Density (Max SDI = 650-850)	QMD all trees >7" DBH (inches)	QMD DF trees >7" DBH (inches)	Top Height	Canopy Cover[1]
29	sugar pine	84	167	340	480	69	19.1	19.1	121	74
59	sugar pine	64	574	259	494	71	14.7	17.5	122	67
61	sugar pine	59	823	160	360	51	14.1	13	85	68
101	serpentine pine	102	172	300	437	62	15.3	15.8	105	59
102	serpentine pine	93	133	240	347	50	18	20.3	108	60
110	sugar pine	63	886	201	438	63	13.7	12.6	83	68
116	sugar pine	64	963	185	416	59	13.4	24.2	87	61
118	sugar pine	74	732	198	417	60	13.4	13.3	119	68
123	sugar pine	68	581	284	532	76	13.5	21.3	105	64
155	serpentine pine	107	453	185	359	51	13.2	12.8	76	59
158	serpentine pine	112	1105	159	380	54	12.8	13.3	69	68
	Averages	**81**	**599**	**228**	**424**	**61**	**15**	**17**	**98**	**65**

Abbreviations: TPA (Trees per Acre), DF (Douglas-fir), BA (Basal Area), SDI (Stand Density Index), RD (Relative Density) QMD (Quadratic Mean Diameter measured at breast height), CC (Canopy Cover – values calculated in Forest Vegetation Simulator).

Need for treatment

Sugar pine (*Pinus lambertiana*) stands are naturally regenerated stands that established after fires from 1900-1930s. Following the fires, these stands naturally regenerated with sugar pine, knobcone pine, Douglas-fir, giant chinquapin, western white pine, Jeffrey pine, and other species. Large sugar pines that survived the fires have grown in open conditions for 70+ years, resulting large open grown tree form.

In this landscape, under a natural, mixed severity fire regime, species like sugar pine would have more opportunities to persist and regenerate with fire shaping vegetation patterns and stand structures. In the absence of disturbance, these stands are currently developing in dense stand conditions, typical of the stem-exclusion stage of stand development. Competition from Douglas-fir and hardwood species are resulting in crown recession and decreased vigor in the pines. This decreased vigor makes the pines less resilient and vigorous, leaving them vulnerable to disturbance agents that can contribute to tree mortality. White pine blister rust has been a contributing factor for mortality of large overstory and regeneration of sugar pine and western white pine. Mortality of sugar pine and other five needle pines is high across SW Oregon and this planning area (Goheen and Goheen 2014).

Continued fire suppression and no restoration treatments would result in continued mortality of sugar pine, and lower composition of this important component of late-successional forests. In many of the proposed treatment stands, the sugar pine are the largest trees in the stands. They can grow to be large trees, provide large quantities of nutritious seeds, and persist as long lasting large snags. This is not only about conserving sugar pine, but also about conserving plant communities that would have existed with more frequent fire on the landscape. The homogenizing of the landscape to Douglas-fir and tanoak forests is resulting in lower diversity of trees, shrubs, and herbaceous plant communities that relied on fire to maintain some open canopy conditions.

Why cut over 80 years of age? In proposed action, 53 acres of the 549 acres identified for sugar pine have overstory trees that are greater than 80 years old. In the sugar pine stands, not treating the overstory (which is over 80) would make the stand density reduction and pine release infeasible in these 53 acres. In these stands this would result in a prolonged stem-exclusion stage and loss of species diversity.

Why cut trees greater than 20 inches? Prescribing for cutting these larger trees allows for effective, full release around most sugar pines, western white pines, and Jeffrey pines that are currently in competition with surrounding Douglas-fir. A 20 inch limit will affect the ability to achieve release around some pines, likely resulting in a higher mortality rate in overstory pines. Cutting trees over 20 inches in diameter will allow for a more effectively reduction in overstory canopy cover to get sunlight to the forest floor and create conditions for development of a late-open stand structure with good representation of the shade-intolerant pine species.

This prescription proposes cutting larger trees up to 26 inches DBH if within radial release distance of desirable pines or within gaps. Cutting up to 22 inches in would occur in thinning areas where live pines are not currently present. Prescribing for cutting these larger trees allow for effective, full release around most sugar pines, western white pines, and Jeffrey pines that are currently in competition with surrounding Douglas-fir. Jeffrey pine are considered to be shade intolerant, while sugar pine and western white pine have intermediate shade tolerance. Sugar pine tends to be less shade tolerant as it matures (Minore 1979) and may require lower densities and canopy closures for sustained growth and recruitment into the overstory (Gray and others 2005). Release treatments around sugar pine in a 9-year study in Southwest Oregon (Goheen 2011), showed that treatments increased growth, decreased tree mortality, and increased sugar pine regeneration. During the study period, the mortality of sugar pine in the full release treatments decreased by 50% compared to untreated areas. Partial release treatments showed about a 25% decrease in mortality compared to the untreated areas. Full release treatments consisted of clearing all trees within 25 feet of the dripline of a sugar pine, while partial release cleared trees within 10 feet of dripline. Cutting of trees to achieve a full release or a release while maintaining the largest trees (>28") will likely result in better pine survival. A 20 inch limit will affect the ability to achieve full release around some pines, likely resulting in a higher mortality rate in overstory pines.

Why create gaps up to 2 acres? Two acre gaps are proposed for 2 primary purposes. The first purpose is to create open areas large enough to provide opportunities for successful regeneration of pines and recruitment into the overstory. The second purpose of the larger gaps is to create a heterogeneous pattern across the landscape, with open areas for small patches of early seral species.

The primary purpose for larger gaps is to create open areas of optimal size to provide opportunities for successful regeneration of pines and recruitment into the overstory. These areas would be focus areas for planting of disease resistant sugar pine and western white pine. A study on seedling tree height growth response following gap creation found that shading edge effect can be minimized when gaps are larger than 1.5 acres (York and others 2004). Gaps greater than 1.5 acres in size will allow disease resistant pines to establish and quickly become overstory trees, capable of reproducing and perpetuating genetic resistance to white pine blister rust into the future. These areas along with other areas planted with disease resistant 5 needle pines can become an important seed source for perpetuating and maintaining these pine into the future as an important part of late-successional forests in southern Oregon. Sugar pine may be important to spotted owls, because it produces large seeds important to owl prey species. Sugar pine basal area (proportion of stand in sugar pine) exerted a strong effect on resource selection for owls in southern Oregon and northern California (Irwin and others 2012). As a result, the sugar pine treatments would likely benefit spotted owl prey and improve foraging habitat. Sustaining sugar pine on the landscape into the future is an important management goal for maintaining species diversity, but also for continued and improved mast production that will benefit prey species and improve foraging habitat for the NSO.

The second purpose of the larger gaps is to create a heterogeneous pattern across the landscape, with open areas for small patches of early seral species. This would be a start at restoring vegetation patterns associated with the mixed severity fire regime that shaped the patterns, species composition, and stand structures. This mosaic distribution pattern is also part of the landscape-level late successional forest structure, and is an important for biodiversity and ecosystem resilience. The 2011 Recovery Plan for the Northern Spotted Owl (USDI Fish and Wildlife Service 2011)(III-14) recognizes ecological management principles are important to provide resilient ecosystems in the face of climate change. Managers should promote spatial heterogeneity within patches and local and regional landscapes, restore lost species and structural diversity (including hardwoods) within the historical range of variability, and restore ecological processes to historical levels and intensities (Franklin and others 2002) (Drever and others 2006) (Long 2009). Proposing up to 2 acre openings in areas that aren't capable of developing into NSO habitat would re-introduce these patterns at a small scale, while not sacrificing current or future NSO habitat. These areas would represent an insignificant portion of the planning area (0.02%) and LSR (0.01%). See Figure 20 for an example of vegetation patterns in 1940.

Desired Future Conditions

The desired future condition of sugar pine stands would be a late-open forest structure with large sugar pine, Douglas-fir, and hardwoods. The canopy cover of these stands trees would ideally be below 60% on average and very patchy. Patches of thick brush persist in some areas, to provide good hiding cover for wildlife, especially the Pacific marten. Large sugar pines would continue to have adequate space to grow, relatively free from Douglas-fir competition. The sugar pine would have good vigor, and be more resilient to forest insects and pathogens. Patches of open areas would allow for recruitment of rust-resistant sugar pine and western white pine stock (planted) to mature and reproduce, creating the next generation of 5 needle pines with genetic resistance to the exotic disease.

This forest would look like and function as late-successional forest, but with lower canopy covers and a more diverse mix of flora species that would be better represented under natural fire regimes. Most areas would be maintained with prescribed fire, but frequency and intensity would vary, as they would have under a natural mixed severity fire regime. Large snags and down wood would be present in adequate amounts and would be created through prescribed fire.

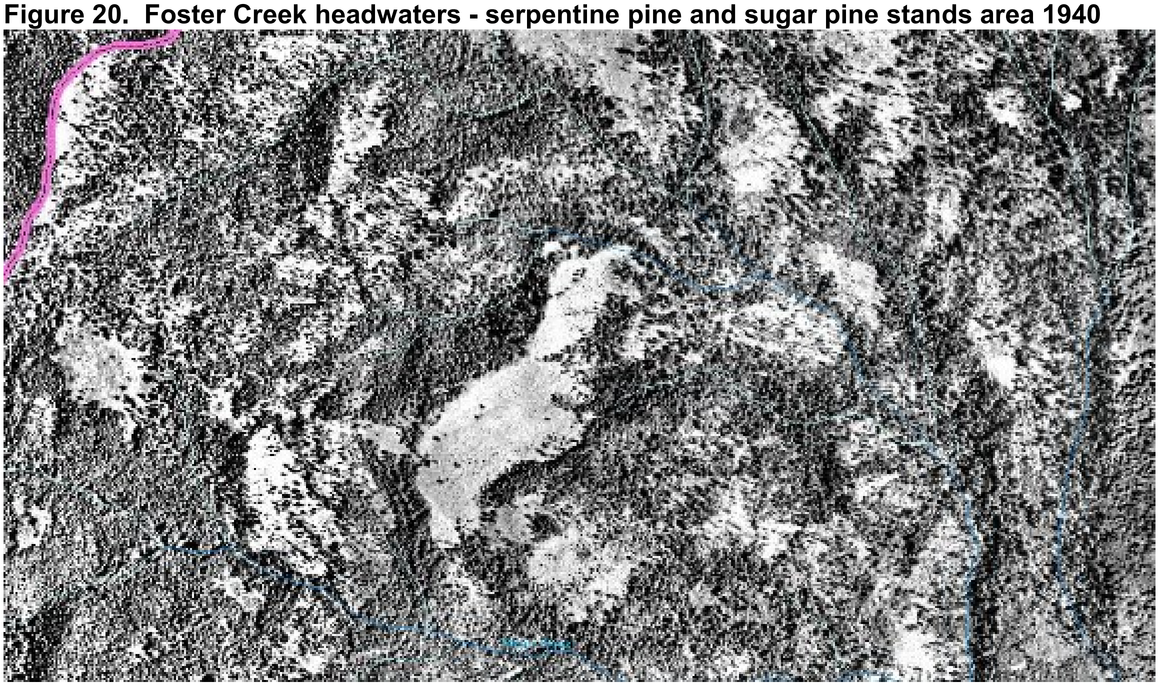
Serpentine pine stands and savannahs

Serpentine pine stands development

These stands have developed in a wide variety of conditions in the planning area. Primary factors include degree of peridotite and serpentinite influence of the soils, effects of previous fires, the time since the last fire, and effects of white pine blister rust on the five needle pines.

All of these stands are located in soils that developed from ultramafic parent materials such as peridotite and serpentinite. Due to low nutrient availability and concentrations of heavy metals, some vegetation commonly found in the planning area does not establish and grow well in these soils. Douglas-fir and tanoak (*Northolithocarpus densiflorus*) can be found in these soil types, but vigor and growth rates are considerably slower than in other soil types in the area. In some serpentine areas, Douglas-fir and tanoak cannot establish and survive. Trees better adapted to these soils include: Jeffrey pine, western white pine, knobcone pine, incense cedar (*Calocedrus decurrens*), and Port-Orford-cedar.

Figure 20. Foster Creek headwaters - serpentine pine and sugar pine stands area 1940

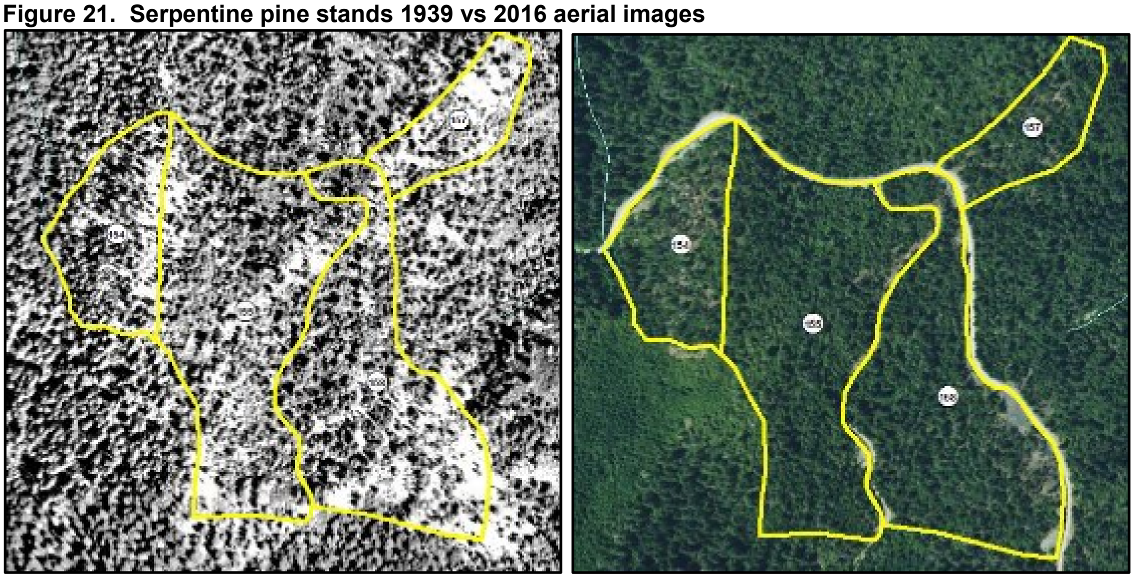


Heterogeneous vegetation patterns in 1940, resulting from soils and a mixed-severity fire disturbance history.

Fire effects and timing of previous fires in the serpentine pine stands are not known. Current stand structures and 1939 aerial photo interpretation suggest that fairly frequent fire maintained these stands in a late open condition (See Figure 20). Many of these stands would have been described as a serpentine savannah. These serpentines savannas are characterized by an open Jeffrey pine, sugar pine, and incense cedar overstory with a more or less continuous herbaceous layer dominated by Idaho fescue (*Festuca idahoensis*) and patches or brush including coffee berry (*Rhamnus californica*). In drainages and concave slopes more Port-Orford-cedar and higher brush cover would be generally be expected. These serpentine savannahs are associated with one of the highest frequencies of sensitive and rare plants in the Klamath Mountains (Whittaker 1960) (Duebendorfer 1987) (Goforth and Veirs 1989) (Jimerson and others 1995) (McGee-Houghton 1995).

Observations suggest that many of these stands incurred frequent, low or mixed severity fires that maintained a late-open stand structure. As fire suppression in the planning area has occurred, the structure and composition of these stands has changed. Areas historically occupied by open pine savannahs have experienced dense regeneration of pine species, incense cedar, tanoak, and brush species. Douglas-fir and other species from the surrounding forest are also encroaching, and is likely to negatively impact species diversity by changing soil and light conditions and by reducing the amount of area available for herbaceous plants. Additionally, tree encroachment homogenizes the landscape by increasing the area of forest habitat, thereby reducing landscape-level heterogeneity (Sahara 2012).

Figure 21. Serpentine pine stands 1939 vs 2016 aerial images



Low overstory density in serpentine influences areas.

Stand structures of these serpentine stands are quite variable depending on the degree of peridotite and serpentinite influence of the soils. Some stands with more productive forest soils have a higher density stand structure with more Douglas-fir competing with overstory pines. Other stands have maintained a relatively open overstory, but now have a very dense midstory cohort, dense brush layers, and plentiful regeneration of tanoak and incense cedar. Relatively little stand exam data was collected within these stands. See #101, 102, 155, and 158 for stand information in Table 15.

Need for treatment

Serpentine savannah and the associated pine stands' structure and density has changed dramatically in the absence of fire on the landscape. Open forest structures have been replaced by closed canopy forests or have very dense mid-story canopies. Vegetation composition and structure are shifting due to the slow invasion and increased density of trees and shrubs. Open stand conditions are important in serpentine areas to promote a diverse herbaceous and grassy understory. Though these serpentine savannahs may not support forest structure typical of NSO nesting or roosting habitat, they do support larger pine, which are important mast producers. Serpentine pine savannahs also contribute to the diverse mosaic of unique habitat that support ecosystem resilience. Without thinning, these open canopy structures supporting larger mast producers would not persist. Under current conditions, without restoration treatments prescribed fire would burn hotter and more intensely than desired.

Figure 22. Pictures of serpentine pine stands

Jeffrey pine (*Pinus jeffreyi*) is a shade intolerant species, eventually replaced by shade-tolerant conifers in the absence of fire or other disturbance. Trees become fire-resistant with age, and regular, low-intensity fire facilitates the persistence of pines. For the past 60+ years, fire conditions have been suppressed, leading to denser stand conditions in historically open serpentine areas with Jeffrey pine, sugar pine, and western white pine. Jeffrey pine forests are often open enough to let in considerable sunlight hence rare serpentine plants associate with this kind of habitat (USDA Forest Service and USDI Bureau of Land Management 2004). These serpentine savannahs are associated with one of the highest frequencies of sensitive and rare plants in the Klamath Mountains (Whittaker 1960) (Duebendorfer 1987) (Goforth and Veirs 1989) (Jimerson and others 1995) (McGee-Houghton 1995). Serpentine pine savanna provides habitat for several endemic species and sensitive species (*Monardella purpurea, Arctostaphylos hispidula*).

Why cut over 80 years of age? In proposed action, all of the stands identified for serpentine pine restoration have overstory Douglas fir trees that are greater than 80 years old. Within the serpentine pine stands, some level of meaningful treatment could still be achieved without cutting trees over 80. These treatments would focus on reducing midstory and understory ingrowth and could reduce stand densities to release some pines and create a more open stand structure. However, release around pines would be limited, as any trees that are competing with these much older pines in the overstory are generally older than 80 years. Without cutting trees over 80 years old, release around these important legacy pines would be very limited, reducing the resilience and vigor of these pines, potentially leading to mortality. Removing an insufficient number of Douglas fir would lead to a continued reduction in the levels of species biodiversity, endemic species, and mast producers important for prey production would continue to decline in numbers across this landscape.

The 80 year restriction is more limiting than the 20 inch diameter limitation, because in these stands Douglas fir tends to be older and relatively smaller in diameter. The proposal to treat unique serpentine and sugar pine habitat via cutting some over 80-yr-old trees along with trees over 20 inches was considered necessary to more fully meet the purpose of achieving resilience and ecological integrity over a longer time period. In order for these mast producers and their endemic plant associations to persist into the longer-term, the need for density reduction and reduced competition would not be met by adhering to 80-yr-old or 20-in limitations.

Why cut over 20 inches DBH? See section for Need for treatment under the sugar pine section.

Desired Future Conditions

The desired future condition of these serpentine areas would vary widely, just as the current vegetation patterns in these soils vary widely. The general trend would be lower forest densities across the serpentine restoration stands, resulting in higher flora species richness. This late-open forest structure is very open in some areas with canopy covers below 40% on average. Other areas may have canopy covers between 40% and 60%, but not generally higher than 60%. Sugar pines, western white pine, and Jeffrey pine would be growing relatively free from competition of Douglas-fir, incense cedar, and hardwoods. Open areas would allow for recruitment of rust-resistant sugar pine and western white pine stock (planted) to mature and reproduce, creating the next generation of 5 needle pines with genetic resistance to the exotic disease.

Overstory canopy cover in lower densities would provide ample sunlight to the pine regeneration and promote grass, forbs, and brush species. Since many of the common and rare serpentine associated species depend on open canopy conditions, keeping fire as the primary disturbance mechanism would be important. Most areas would be maintained with prescribed fire, but frequency and intensity would vary, as they would have under a natural mixed severity fire regime. This disturbance would also keep competition low between overstory trees, keeping tree vigor and resiliency high, especially for the pines.

Sugar pine and serpentine pine silviculture actions

Variable density treatments are proposed within pine stands including: expanding existing serpentine pine savannah openings, radial release around Jeffrey pine, sugar pine, and western white pine, thinning to reduce stand density, creation of gaps, and skips. Primary target species to cut to reduce stand density include Douglas-fir, tanoak, giant chinquapin, incense cedar, and knobcone pine. Treatments would utilize commercial logging techniques, handsaw work, and prescribed fire to reduce stand densities. Treatments within serpentine pine stands is mostly non-commercial, with 130 acres of commercial treatments proposed.

Restoring serpentine savannah openings would involve removing mostly smaller trees from the edge of open savannah areas and pines. For most of these areas encroachment into the savannahs is a slow process and most treatments will be performed with handsaw work.

Variable density thinning is proposed, aimed at creating a clumpy distribution of trees, with reductions in canopy cover to promote a late-open forest structure with opportunities for development of pines. Part of what creates the variable density is the radial release cutting of most conifers and hardwoods within 35-60 feet of pines suitable for release from competing trees. Target canopy covers ranges from 0-20% in serpentine pine savannahs, 20-40% in mixed pine forests that currently have low overstory canopy cover, and 40-60% in mixed pine stands that are currently closed canopy. Cutting of small trees and brush in the midstory and understory will occur throughout the majority of these treatment area. Some fuels piling or other fuels treatments will be required in some areas prior to prescribed fire.

Intentionally created openings (“gaps”) would be strategically placed throughout stands to promote early seral species and pine regeneration. Gap creation would range from ¼ to 2 acre in size, depending on alternative, and would not cover more than 20 percent of a stand area. Gaps would be designed to take advantage of and overlap areas where stand conditions are already mostly open to further create sufficient openings that provide opportunities for successful regeneration of pines and recruitment into the overstory.

Skips would occur throughout the treatment areas where there are few pines, in riparian areas close to streams, and in areas for resource protection. These areas may not be totally skipped, as some hand-cutting may be deemed necessary in skips to ensure the desired fire effects are achieved during prescribed fire.

If snag levels are low following cutting and fire treatments, snags and large down wood would be created in identified restoration units using a variety of methods: girdling, topping and de-limbing, and inoculation. Created snags would be distributed as individuals or clumps across all treatment types (thinned, skips, gaps).

Planting of disease resistant sugar pine and western white pine would occur in open areas where they are likely to be recruited into the overstory and reproduce. Planting of disease resistant Port-Orford-cedar may also occur in appropriate areas, especially in serpentine areas. Seeding of native grasses, pollinator species, and planting of native shrubs may also occur. Seeding or planting of serpentine associated and Sensitive plants such as Gasquet manzanita (*Arctostaphylos hispidula*) may occur.

Sugar pine and Serpentine stand prescription alternatives

Sugar pine and serpentine pine stand treatments also vary by alternative in size of trees to cut, gap size, and in scale. Sugar pine and serpentine pine stands are proposed for treatment in Alternative 1 and 3, but not in Alternative 2. Prescriptions considered but not analyzed in detail include only cutting small trees less than 80 years old and a maximum scope alternative that considered heavy overstory treatments. Table 16 below displays the alternative comparison.

No action

The no action alternative would provide little to no opportunities for restoring serpentine and sugar pine forest stands. Some treatments in young plantation could be implemented that would enhance development of pines and encourage development of a late-open forest structure in these areas. Sugar pine in the candidate stands would continue to succumb to competition based mortality in dense, stem-exclusion stage stands. Sugar pine in other areas where inter-tree competition is lower, these trees will likely survive for decades until dense stand conditions prevail, reducing vigor and resilience of these pines. In sampled stands, FVS projections under a no action prescription show nearly a 50% reduction in live trees per acre in sugar pine greater than 6 inches DBH over the next 80 years. Even in stands that where sugar pine is currently under less competition from Douglas-fir (Stand 110), FVS projections show an 85% reduction in live trees per acre of sugar pine over the next 80 years. Without restoration, the landscape is predicted to support much fewer sugar pine trees, resulting in loss of species diversity and an important mast producer for many late-successional wildlife species.

Under the no action alternative, there would be no planting of disease resistant sugar pine and western white pine. White pine blister rust would continue to cause top-kill, reduced ability for natural regeneration, and would be a contributing factor to reduced tree vigor and mortality of overstory pines in future generations of five needle pines in the area. Beyond the health of pine tree species, not reducing stand densities would result in continued dense, closed-canopy stand conditions that are highly departed from conditions that would likely occur under a natural fire regime. In the absence of fire or restoration treatments, modeling indicates continued homogenization of the vegetation species and stand structures across the landscape. More closed-canopy stands with an overstory dominated by Douglas-fir and midstory of tanoak is the outcome projected by FVS.

Proposed Action

The proposed action prescription proposes stand density reduction and gap creation to promote sustainability and resilience of pine species and the associated vegetation community, while not reducing the ability of capable stands to develop into Nesting Roosting Foraging (NRF) habitat for northern spotted owl (NSO). Thinning, radial release around pines, and gap creation would create a much more open stand condition more conducive to developing existing pines, developing regeneration of planted disease resistant pines, and encouraging establishment and persistence of grass/forbs/shrubs.

Table 16. Sugar pine and serpentine pine silviculture treatment comparison

Treatment parameter	Alternative 1 (proposed action)	Alternative 2	Alternative 3
Largest tree cut for radial release of pines and gaps (DBH)	26"	0"	20"
Largest tree cut for thinning areas (DBH)	24" SP/ 20" serp	0"	20"
Oldest tree cut sugar pine stands (years)	100 years	0	100 years
Oldest tree cut serpentine pine stands (years)	120 years	0	120 years
Largest gap size	2 acres	0	3/4 acre
Canopy cover reduced below 40% in serpentine areas (acres)[1]	64 acres	0	0
Mapped riparian areas treated (acres)	113	0	113

[1]Reduction of existing canopy cover to below 40% will result in removal of northern spotted owl dispersal habitat, however areas are considered incapable of achieving NRF habitat.

FVS modeling projects that this type of prescription may cut about 2000 trees greater than 20 inches DBH across the sugar pine and serpentine pine stands (1033 acres), with very few trees larger than 26 inches DBH cut. Under this simulation, averaged across all pine treatment stands, approximately 15% of trees greater than 20 inches would be harvested. Some stands with higher average diameters would harvest more than others, but allowing for cutting trees over 20 inches is critical to achieve full release of pines and potentially for the creation of gaps. It is important to remember, FVS modeling is a simplified version of the prescription and it doesn't accurately account for radial thinning around pines. The final stand prescriptions would be promote heterogeneous conditions and would be tailored to the specific unit conditions, including slope aspect, stand density, species composition, implementation feasibility, etc.

The proposed action proposes up to 2 acre gaps (total of 10 gaps) in areas that are not currently dispersal and are not capable of becoming Nesting Roosting Foraging (NRF) habitat for the northern spotted owl (NSO). These are generally areas of poorly developed soils with some degree of serpentine soils.

Table 17. Sugar pine and serpentine pine silviculture prescription comparison by acres

Prescription	Prescription - Description	Alt. 1 acres	Alt. 2 acres	Alt. 3 acres
Serpentine savannah maintenance	Non-commercial cutting, prescribed fire	17	0	17
Serpentine pine release/thin/small gaps	Radial release of pines, moderate to heavy thin, gaps up to 3/4 acre CC 40-60%, prescribed fire	186	0	185
Serpentine pine release/thin/large gaps	Radial release of pines, thin, and gaps up to 2 acres to plant pine regeneration, CC 20-40%, prescribed fire	282	0	282
Sugar pine release/thin/small gaps	Radial release of pines, moderate to heavy thin, gaps up to 3/4 acre CC 40-60%, prescribed fire	433	0	415
Sugar pine release/thin/large gaps	Radial release of pines, thin, and gaps up to 2 acres to plant pine regeneration, CC 20-40%, prescribed fire	116	0	116
Rx fire	Only cut small material required to achieve desired results in Rx burn, prescribed fire	809	0	0
Totals		**1843**	**0**	**1015**

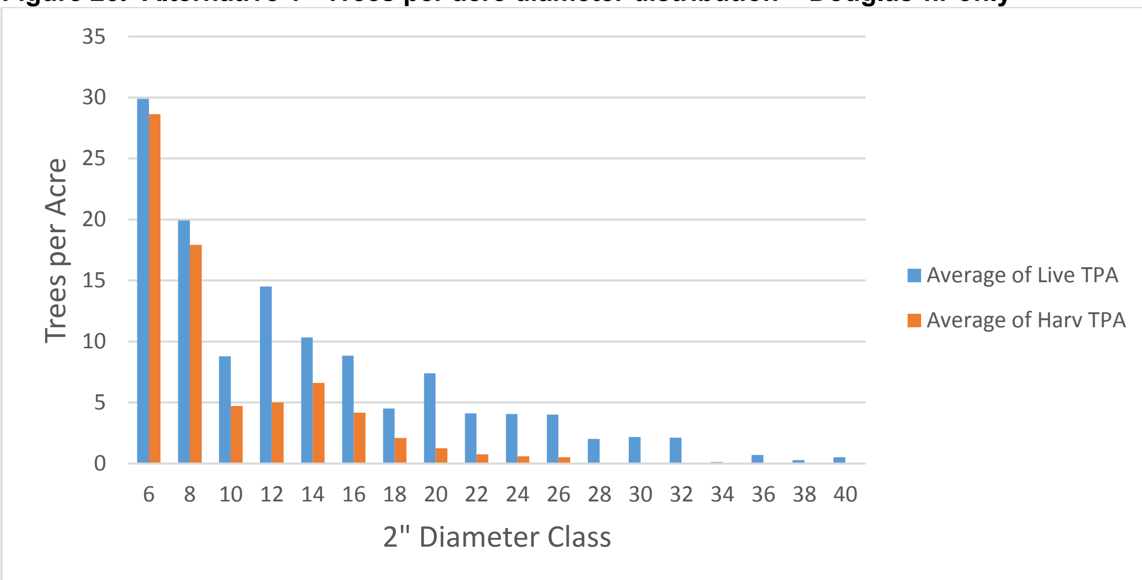
Post Treatment Conditions

Following the proposed treatments, sugar pine stands and serpentine pine stands would generally have a much more open canopy. Pine species would have space between crowns of competing trees. Gaps would have planted sugar pine and western white pine growing in open sunlight conditions. The stands would have a heterogeneous pattern of thinned stands, open gaps, and untreated areas. Prescribed fire may result in some overstory mortality, further contributing to a complex pattern of vegetation and structure that may have occurred in a mixed severity fire regime.

Sugar pine stands would have sugar pine that are growing in open canopy condition with little competition from competing conifers or hardwoods. The largest Douglas-fir would remain and be found in a variable distribution. Hardwoods (chinquapin, tanoak, and madrone) would be present in a lower density than current conditions, focusing growth and fewer trees. Clumpy patches of larger trees would remain and other areas would be widely spaced Douglas-fir. Gaps would be variable in size (¼ acre to 2 acres), and oriented on ridgelines and south aspects to receive maximum solar exposure. Planted, disease-resistant sugar pine would be growing in open sunlight conditions and early-seral species would be present. Skips would be focused in areas within riparian area, within patches of hardwoods, and areas of larger trees without pines. Stands would have 30-100 trees per acre (>7” DBH) and maintain 40% canopy cover average across the stand. Basal area will range between 100 and 140 ft2/acre. No NSO habitat would be downgraded/removed in sugar pine stands.

Serpentine pine stands would have an open overstory canopy, with a mix of Jeffrey pine, sugar pine, western white pine, incense-cedar and Port-Orford-cedar in the canopy. Pine species would have very little competition from competing trees. Larger trees would be present in a clumpy distribution, with canopy gaps in-between clumps. An open overstory canopy would help create an understory vegetation community that would be a mix of open, herbaceous savannah and shrubs present in serpentine areas (coffee berry, manzanita, and tanoak). Serpentine savannahs would dissect the stands with scattered pines and a grassy and herbaceous ground cover. Many of the serpentine pine stands (282 acres) are currently not functioning as NSO dispersal habitat (>40% CC) and treatments will maintain an open overstory canopy in these areas. An additional 64 acres of current dispersal (not capable of NRF) will be reduced to below 40% canopy cover.

Figure 23. Alternative 1– Trees per acre diameter distribution – Douglas-fir only



The vertical (Y) axis is the Douglas-fir trees per acre average across all the pine stands. The horizontal axis is the two inch diameter class. Current live trees are displayed in blue and estimated harvest trees are in orange.

Table 18 displays estimates from FVS model simulations that modeled reducing canopy cover to 40%. These figures provide an estimate of post-harvest conditions in stand averages, recognizing that residual stand conditions will be highly variable. Target canopy covers are from on the ground assessments and spatial data that identified forest types, current forest structure, and NSO habitat conditions. These target canopy covers were designed with all of these in mind and are spatial identified in the project GIS. The weighted average canopy cover is based on the area (% of stand acreage) treated to that intensity. In these stands, there are currently and will be areas with canopy covers below 40% (% stand 0-20 CC and % stand 20-40 CC). Some areas of dispersal will be downgraded (~64 acres). Other areas will maintain above 40% in current dispersal and foraging habitat.

Effectiveness measures post treatment includes: stand composition - higher percentage of pines (% compositions measured by trees per acre, canopy cover, or basal area), lower stand density (measured by stand density index), successful regeneration of pines (% survival following planting or natural regeneration), increased vigor in pines (diameter growth rate increase), reduction in risk of stand replacement fire (flame-length, fireline intensity), and increased individual tree growth in Douglas-fir and pine species.

Table 18. Post treatment conditions in pine stands

Stand #	Stand Type	Total TPA > 7 inches DBH	QMD trees >7" DBH (inches)	Basal Area ft2 /acre	Relative Density	[1]Percent stand 0-20% CC	Percent stand 20-40% CC	Percent stand 40-60% CC	Percent stand >60% CC	Percent stand in skips	Weight Avg CC
29	Sugar pine	30	30	140	27	13	0	73	0	14	41
59	Sugar pine	41	26	140	29	17	0	70	0	13	40
61	Sugar pine	103	14	120	34	6	19	62	0	13	40
101	Serpentine pine	36	33	180	38	18	0	65	0	17	41
102	Serpentine pine	46	24	140	30	16	0	71	0	13	40
110	Sugar pine	84	17	120	38	15	0	72	0	13	40
116	Sugar pine	86	17	120	35	14	19	49	0	18	40
118	Sugar pine	78	18	100	34	14	0	72	0	14	40
123	Sugar pine	45	24	120	29	16	0	71	0	13	40
155	Serpentine pine	60	17	100	25	8	0	79	0	13	40
158	Serpentine pine	75	14	80	23	8	0	77	0	15	40
Averages		**62**	**21**	**124**	**31**	**12**	**3**	**71**	**0**	**14**	**40**

Stands in table are only for sampled stands. Abbreviations: FVS (Forest Vegetation Simulator – growth and yield stand modeling software), TPA (Trees per Acre), QMD (Quadratic Mean Diameter measured at breast height), CC (Canopy Cover), and Weight Avg CC (Weighted average canopy cover of stands posted treatment). [1]Percent of stand canopy cover numbers show the % of the area in the stand that would have a canopy cover in that range. Some treatment areas already have canopy covers between 0-40% and others will be reduced below 40% canopy cover (resulting in removal of NSO dispersal habitat).

Plantations

In the project area, approximately 7700 acres of presumably old growth forests were removed through clearcutting from 1960 to 1997. The plantations this project is focusing on (1635 acres) are plantations that are not already covered by other NEPA decisions, and were harvested between 1960 and 1975. After harvest, these stands were typically planted with Douglas-fir and managed for future timber production. As a result, these stands typically lack structural and species diversity and are growing in dense and homogenous conditions. As such, young plantation stands are developing in dense conditions that will delay or not achieve late successional characteristics that are suitable for species dependent on late seral habitat. These stands would benefit from variable density treatment that promote accelerated development of late seral conditions.

Need for Treatment

Stands were clearcut in the project area from the early 1960s to the middle of the 1990s. These clearcuts where mostly planted with Douglas-fir and previously managed for timber production, resulting in the current homogenous, high density stand conditions with little species diversity. These are not resilient stands, are susceptible to natural disturbances, and stand conditions are not conducive to developing of late successional conditions. This project would treat these plantations with variable density thinning treatments to promote development of a complex forest structure with large trees and species diversity.

Why create ¾ acre gaps? This is consistent with LSR objectives because the NWFP states one of the roles of silviculture is to create canopy gaps that enable the establishment of multiple tree layers and diverse species composition (NWFP, B-5). 3/4 acre gaps are proposed for 3 primary purposes. The first objective is to create sufficiently open areas large enough to provide opportunities for successful regeneration of pines and recruitment into the overstory, while not removing too large of an areas that could become future NRF habitat for the NSO. These areas would be focus areas for planting of disease resistant sugar pine, western white pine, and allow for natural regeneration. The second objective is to produce large trees along edges of gap, creating a variable and complex stand structure that would develop into NRF for NSO. In order to better accelerate development of stand structure that better meet the long-term nesting site needs of spotted owls, silviculture activities may need to be permitted that go beyond REO guidelines (Andrews and others 2005). This includes silviculture actions to implement variable density thinning, including activities such as heavy thinning and larger gap sizes. The third purpose of the larger gaps is to promote a heterogeneous pattern and diversity across the landscape, with open areas that promote biodiversity within these stands.

Port-Orford-cedar

Port-Orford-cedar (POC) (*Chamaecyparis lawsoniana*) is an ecologically, culturally, and economically important tree species in its endemic range in southwest Oregon and northern California. POC is an important structural component of late seral forests and within riparian areas for long lasting in-stream structures and stream shading (E. M. Hansen and others 2000). The uses of the tree for American Indians were many, including construction of living areas. POC is highly susceptible to an exotic root disease pathogen (*Phytophthora lateralis*) that results in mortality. This exotic disease has greatly reduced the number of large POC (especially in riparian areas) in the project area. Known POC stands exist on 4700 acres with at least 840 infected acres within the project area.

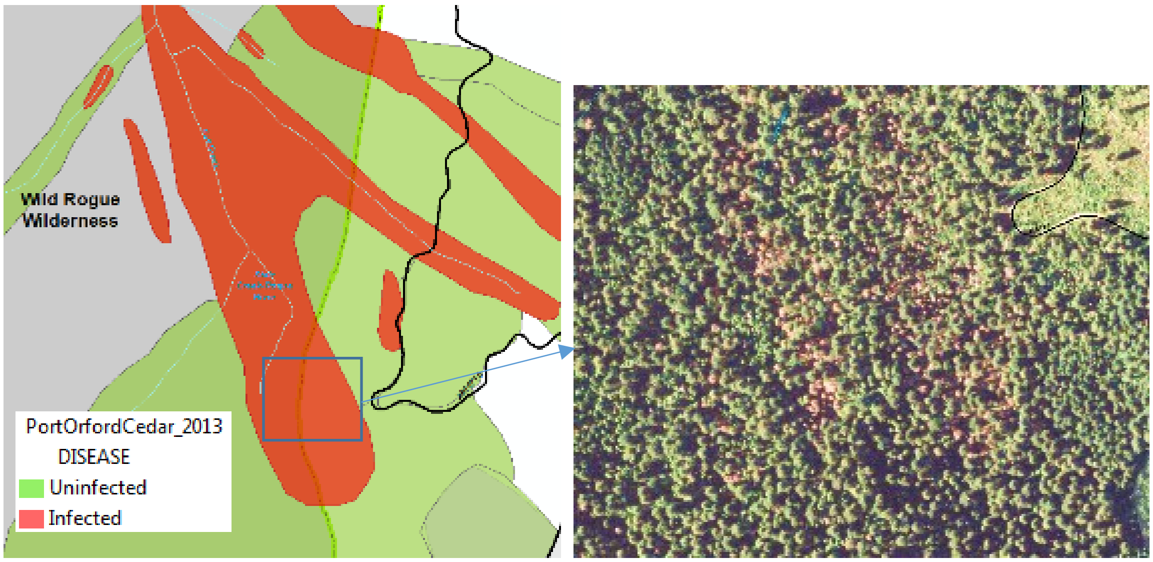
Need for Risk Reduction

Mortality of these infected POC have resulted in large amounts of large, dead POC in riparian areas or areas with high water tables. Roadways are vectors for disease spread. Furthermore, the disease indiscriminately affects all age classes. This has resulted in a change in the stand structure and composition for many of these stands. Canopy cover and POC composition has been reduced as the disease spreads and recruitment of new POC will eventually succumb to mortality if the pathogen persists. Continued spread will reduce the cover and composition in new areas as the disease continues to be spread via open roadways. Figure 24 below shows an example of a relatively recent (2005-2006) infection in the project area that killed POC in over 100 acres within the Wild Rogue Wilderness. The likely source of this infection vehicle transport of the pathogen on open roads, infecting POC along the travel way. The aerial photo illustrates, that a fairly significant portion of the overstory and midstory of POC was affected by the pathogen.

Implementing the applicable POC management practices from the POC ROD (USDA Forest Service 2004) could reduce the risk of spreading the pathogen. Many of the POC management practices would be applied in the project, but only roadside POC sanitation needs to be addressed for consistency with the NWFP.

POC sanitation could reduce the risk of spreading the pathogen within and beyond the planning area. Within the planning area, approximately 3500 acres of the 4700 acres of POC have some connection to a currently open road. This connection could mean they are downhill, downstream, or uphill with contiguous POC composition from an open road. Of the 3500 acres, approximately 800 have or have had some infection in the past, leaving about 2700 acres of uninfected POC that may be vulnerable from infection from these roads. Also, the 800 acres includes previously infected locations that may not currently contain the pathogen. If sanitation was completed on 240 acres, it has the potential to reduce the risk of spreading the pathogen to up to 2700-3500 acres.

Figure 24. 2005-2006 infection of POC in Wild Rogue Wilderness



2005-2006 infection of *Phytophthora lateralis* in the Wild Rogue Wilderness. POC inventory data (left) is from 2013 inventory.

Why cut trees over 80? Sanitation, or removal of all POC trees from high risk zones (areas along open roads and intersections with waterways where the disease can spread via vehicle transport and hydrologic connectivity) is most effective if all of the host species trees are removed. Leaving trees due to their size or age is ineffective at creating a truly host-free zone. No removal of trees is proposed within riparian areas and no trees larger than 20 inches diameter are proposed to be removed from uplands. Trees larger than 20 inches would be cut, but remain on site to contribute to large down wood.

NWFP and Risk Reduction

The POC sanitation treatments are proposed to be exempted treatments in LSR because they reduced the risk of continued spread of an exotic pathogen that has negative effects on an endemic late-seral species and late-successional forest structure. This section will define how this proposed treatment meets the following 3 criteria for risk reduction in older stands (NWFP, C-13)

- (1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat
    - *Within the planning area, approximately 3500 acres of the 4700 acres of POC have some connection to a currently open road. This connection could mean they are downhill, downstream, or uphill with contiguous POC composition from an open road. Creating a host-free zone along areas roads where pathogen is transported is one way to reduce the likelihood of continued spread of the pathogen. This treatment reduces the risk of continued loss of an important late-seral and important mid-story species that contributes to late-successional structural complexity.*
- (2) the activities are clearly needed to reduce risks

        - *The spread of the pathogen to uninfected POC populations continues within the planning area (see* Figure 24*). Roadside sanitation is one of the POC management practices recommended by the POC ROD* (USDA Forest Service 2004) *to reduce the risk of continued spread of the pathogen. The proposal would combine this treatment with other required best management practices. However, without removing all of the sources or immediate vectors of the infection along high-risk zones, there is a lower chance of limiting the spread of the disease. The disease affects all age classes.*
    - (3) the activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established
        - *Treatments would occur in 240 acres along open roadways, but could reduce risk on up to 3500 acres. Project design criteria for treatments do not allow for treatments that reduce canopy cover below thresholds for NSO and along streams. No POC would be removed from riparian areas and no POC larger than 20" DBH would be removed from LSR. The limited spatial scale and mitigations for large wood and canopy cover would maintain late-successional forest structure in these stands.*

Desired Future Condition

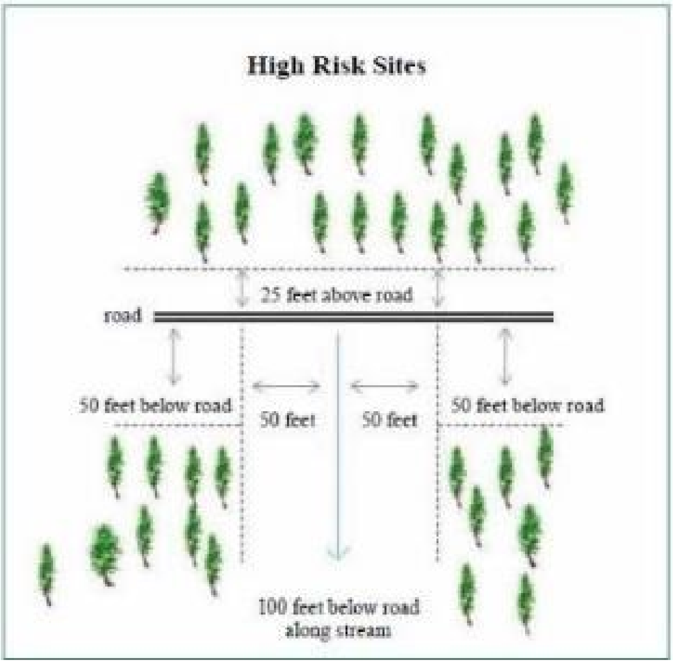
The desired future condition for Port-Orford-cedar (POC) on this landscape is to maintain existing live populations in low risk areas, slow and reduce the risk of spreading the pathogen, and to establish disease resistant genetics in the landscape. Reducing the continued spread of Port-Orford-cedar relies upon several factors, but a key factor is eliminating POC from the high risk zones along open roadways. Removing these live POC and maintaining a host-free-zone along these open roadways can reduce the risk of the pathogen spreading to POC that are uninfected. POC would continue to contribute to late-successional structures through midstory development, ongoing regeneration of this shade-tolerant species, and provide large tree structures. POC would remain established and regenerate within riparian areas, providing an important source of shade and large wood in streams. Disease resistant POC stock would be planted on appropriate sites and would to mature and reproduce, creating the next generation of POC with genetic resistance to the exotic disease.

Port-Orford-cedar silviculture actions

Port-Orford-cedar (POC) sanitation is proposed within high risk areas for spreading of Port-Orford-cedar root disease (*Phytophthora lateralis*). High risk areas are defined as 25 feet above open roads or to top of cut bank, 50 feet above below roads, and 100 feet below roads around stream crossings (USDA Forest Service and USDI Bureau of Land Management 2004). See Figure 25 for diagram of areas where POC will be cut. In these high risk areas, sanitation would involve eliminating or reducing POC (host species). Planting of disease resistant POC is proposed in appropriate sites for POC within the project area. Planting may occur in plantations, serpentine pine stands, and some sugar pine stands. These plantings would not occur within the high risk sites as shown in Figure 25 below.

Treatments will not result in stand canopy cover being reduced below 50% in riparian reserves, below 60% in NSO nesting-roosting-foraging habitat, or below 40% in NSO dispersal habitat. Canopy cover of POC rarely exceeds 10% of the canopy cover in these areas, and maintaining adequate canopy cover in riparian reserves and owl habitat should not be a conflicting objective in most scenarios. Sanitation treatments would not cut, but not remove any POC from riparian areas (175 feet from streams). In upland areas treatments would cut trees larger than 20 inches DBH, but not remove any trees larger than 20 inches DBH

Figure 25. POC sanitation and high risk sites diagram



Cutting of trees older than 80 years old is proposed in POC sanitation. Sanitation treatments are most effective if all of the host species trees are removed (personal communication, Ellen Goheen, 2016). Leaving trees due to their size or age is ineffective at creating a truly host-free zone.

This treatment would look at many miles of road systems, but POC is only found along some sections of roadway. Treatments would occur where POC is present, and mapping for analysis attempts to estimate where treatments will occur based on the POC inventory completed in 2012. Estimated treatment acres reflect this patchy distribution of POC within the planning area. For a summary of estimated acres of treatment of POC sanitation see Table 19.

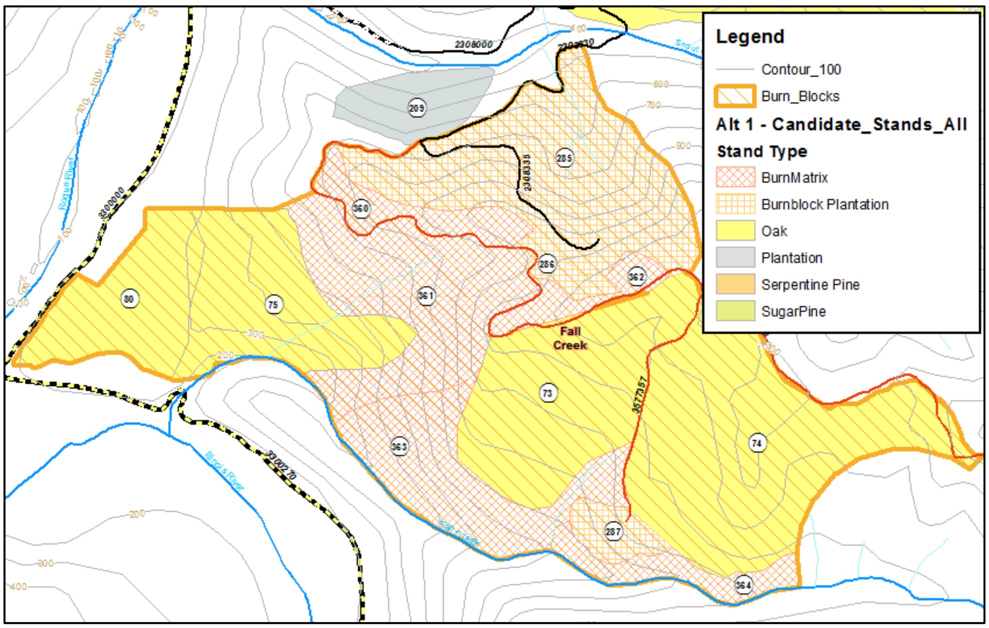
Table 19. POC sanitation and miles of miles of road treated

Watershed	**Acres Treatment**	**Miles of road treated**
Shasta Costa Creek-Rogue River	216	46
Stair Creek-Rogue River	25	6
Totals	**241**	**52**

Prescribed fire burn blocks

There is a need for reintroducing fire to the landscape to emulate natural disturbance and ecological processes. The historical fire regime has been greatly altered by fire suppression. Dense understories and ladder fuels have developed that leave the stands susceptible to stand replacement fires. Some plants are fire dependent and rely on heat from fires for to carry out their lifecycle. This will be an important tool in the restoration of many of these forest types, and will be critical for maintenance of several stand types to achieve the desired future condition.

Figure 26. Fall Creek area burn block example



Areas in red crosshatch display "burn between" areas between the oak restoration stands (yellow). Some areas within this burn matrix have white and black oak.

Shasta Agness proposed applying prescribed fire "burn blocks" to help achieve the restoration objectives and give better implementation flexibility to applying prescribed fire on the ground. There are five burn blocks proposed in Alternative 1 and three proposed in Alternative 2. These areas took stands where many candidate stands were grouped together and included the in-between areas to make for larger continuous areas to apply fire. These in-between areas are referred to as "Burn between" areas. These areas often contain the emphasis species this project is promoting and these stands will benefit from reintroduction of fire in these burn blocks. In some areas hand-cutting may be deemed necessary in skips to ensure the desired fire effects are achieved during prescribed fire. These pre-fire cutting treatments will focus on trees and brush in the understory and midstory. Prescriptions will generally be cutting material less than 12" in diameter. Lop and scatter or hand-piling of fuels may be required in some areas to reduce fuels to appropriate levels to apply prescribed fire. These treatments are considered consistent with LSR and the NWFP. This is addressed as a project that is allowed in LSR according to the Southwest Oregon LSR Assessment on page 62.

Post-treatment conditions with the burn-between areas would change the understory and midstory vegetation more than the overstory vegetation. Treatments would reduce surface fuels, brush composition, and reduce some midstory canopy and small trees. Overstory canopy would remain largely intact. Some single tree mortality or groups of overstory tree mortality is expected. Snags will be created through this treatment area by the fire.

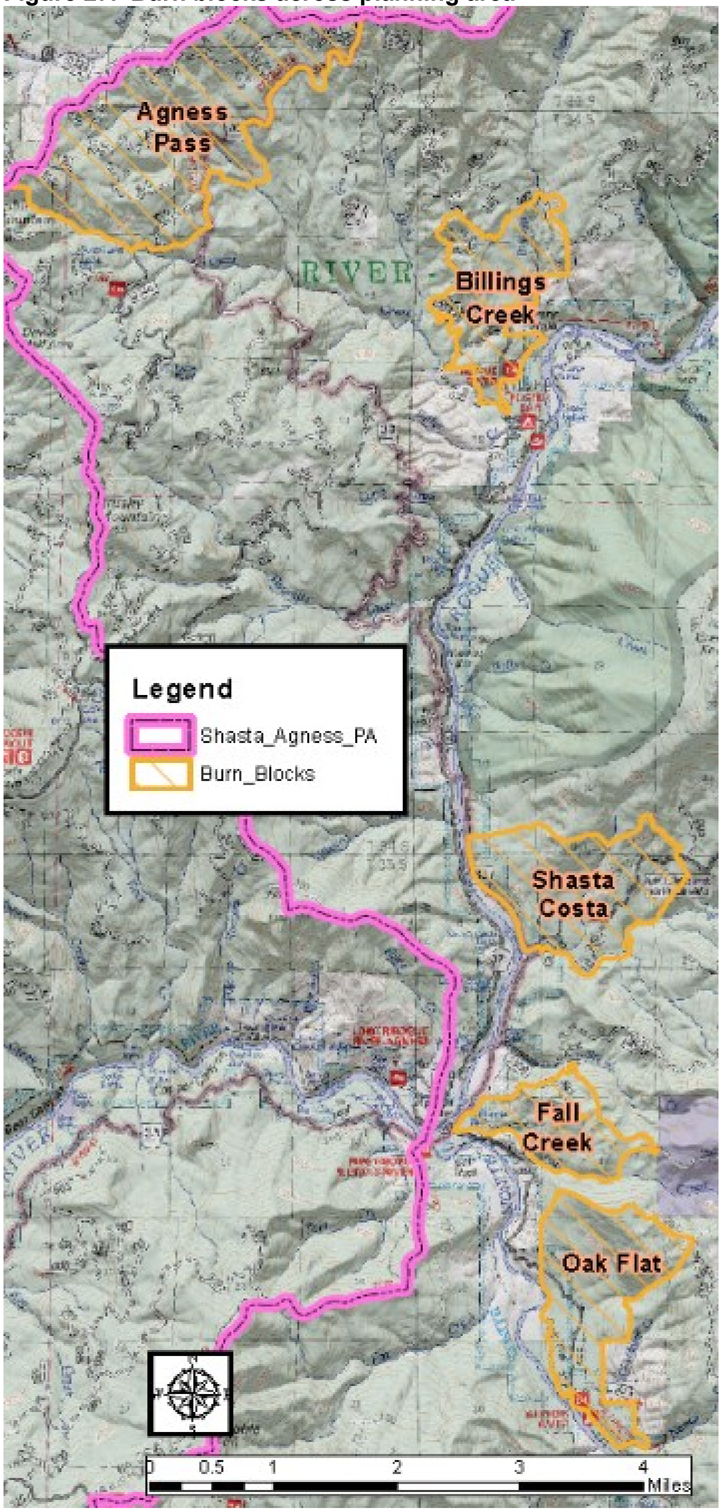


Figure 27. Burn blocks across planning area

Dead wood

Down dead trees (down wood) and standing dead trees (snags) are a critical component on the landscape when managing forest ecosystems. The Forest Service uses DecAID to assess dead wood by forest type and compare current conditions to reference (natural) conditions within a watershed. DecAID is available on the internet. This provides a data for snags and down wood at a landscape scale. This provides a relative starting point for considering how to manage for snags and down wood in the treatment stands given the landscape context.

While snags and down wood need to be considered at multiple scales, it is recognized that at the stand scale there are tradeoffs between benefits of heavy reductions in stand density and dead wood. At this scale, the proposed actions will reduce recruitment of dead wood for many decades. However, it is recognized that under natural conditions the density of snags and down wood varies over space and time. While reductions of down wood and snags will occur within treatment stands, these treatments will not considerably reduce dead wood densities below reference conditions.

DecAID - Down wood and snags

As shown in Table 20, current small and large down wood is better than DecAID reference conditions except in Lawson Creek-Illinois River watershed. In that case, the percent of the watershed with no large down wood is 11% worse than reference conditions (75% versus 64%). This is because the 2002 Biscuit Fire burned a substantial portion of the Lawson Creek watershed, including at intensities high enough to consume large dead wood.

Table 20. Down wood conditions versus DecAID reference conditions relative comparison of watershed.

Watershed	Percent of Watershed Without Small Down Wood (≥5" diameter)			Percent of Watershed Without Large Down Wood (≥20" diameter)		
	Reference	Current	Current vs. Ref.	Reference	Current	Current vs. Ref.
Lawson Cr.	27%	22%	5% better	64%	75%	**11% worse**
Shasta Costa Cr.	28%	14%	14% better	65%	53%	12% better
Stair Cr.	28%	12%	16% better	66%	50%	16% better
Bold red = Current condition does not meet DecAID reference condition.						

Table 21. Comparison of DecAID reference and current conditions of downed wood as a percent of watershed.

Watershed	Reference/ Current	Small Downed Wood (>5" diameter) (% of watershed)						Large Downed Wood (>20" diameter) (% of watershed)					
		0	0-2	2-4	4-6	6-8	≥8	0	0-1	1-2	2-3	3-4	≥4
Lawson Creek	R	27	41	16	8	3	5	64	7	13	6	3	7
	C	22	42	**13**	9	5	9	75	11	**6**	4	2	**3**
Shasta Costa Creek	R	28	42	15	8	3	5	65	7	13	6	3	7
	C	14	**32**	19	11	9	15	53	13	17	8	5	4
Stair Creek	R	28	42	15	7	3	5	66	7	12	6	3	7
	C	12	**33**	24	10	8	13	50	15	18	10	4	**4**
Bold red = Current conditions are below reference conditions. The '0' column indicates % of watershed lacking dead wood.													

As shown in Lawson Creek is departed the furthest (20 and 13 percent respectively of large and small snags), likely due to high intensity fire during the 2002 Biscuit Fire which consumed many large snags. At 8 percent each, Shasta Costa and Stair Creek watersheds are not substantially worse than reference conditions. In all watersheds, the deficit in snags was well distributed across the various quantities of snags per acre reported in DecAID histograms.

Table 22, current small and large snags are worse than DecAID reference conditions in all watersheds; ranging from 6 to 20 percent below reference conditions for the amount of the watershed without measured snags. Large snags range from 8 to 20 percent below reference conditions. When small snags are added in, the range is from 6 to 13 percent below reference conditions.

Lawson Creek is departed the furthest (20 and 13 percent respectively of large and small snags), likely due to high intensity fire during the 2002 Biscuit Fire which consumed many large snags. At 8 percent each, Shasta Costa and Stair Creek watersheds are not substantially worse than reference conditions. In all watersheds, the deficit in snags was well distributed across the various quantities of snags per acre reported in DecAID histograms.

Table 22. Snag conditions versus DecAID reference conditions relative comparison of watershed.

Watershed	Percent of Watershed Without Small Snags (≥10" DBH)			Percent of Watershed Without Large Snags (≥20" DBH)		
	Reference	Current	Current vs. Ref.	Reference	Current	Current vs. Ref.
Lawson Cr.	12%	25%	**13% worse**	27%	47%	**20% worse**
Shasta Costa Cr.	13%	20%	**7% worse**	28%	34%	**8% worse**
Stair Cr.	13%	19%	**6% worse**	28%	34%	**8% worse**
Bold red = Current condition does not meet DecAID reference condition.						

Table 23. Comparison of DecAID reference and current conditions of snags as a percent of watershed.

Watershed	Reference/ Current	Small Snags (>10" dbh) (% of watershed)						Large Snags (>20" dbh) (% of watershed)						
		0	0-4	4-8	8-12	12-24	≥24	0	0-2	2-4	4-6	6-10	10-18	≥18
Lawson Creek	R	12	31	24	14	15	4	27	24	22	12	11	3	1
	C	25	**16**	22	**9**	**10**	18	47	23	**11**	**8**	**7**	4	1
Shasta Costa Creek	R	13	31	24	14	15	4	28	24	22	12	11	3	1
	C	20	**18**	26	17	**11**	7	34	26	**16**	12	**7**	3	2
Stair Creek	R	13	31	24	14	15	4	28	24	22	12	10	3	1
	C	19	**22**	31	14	**8**	7	34	30	**18**	**9**	**5**	3	2

Bold red = Current conditions are below reference conditions. The '0' column indicates % of watershed lacking dead wood.

Site level context

Within treatment stands, standing dead and downed wood are generally at low levels. Most snags are within the smaller diameter classes, likely due to competition in overcrowded stands. There is a lack of very large (≥ 30-inches dbh) snags across the treatment stands. Large snags that do occur in treatment stands are generally caused by droughty soils or diseases such as Port-Orford-cedar root disease (*Phytophthora lateralis*) and white pine blister rust (*Cronatium ribicola*).

Snags are present throughout these treatment units, but are often found in a clumpy distribution. Snag data was collected during stand exams, but due to the often very clumpy distribution of snags, capturing conifer snag density information is difficult. Larger snags and snag patches are concentrated around existing white oak savannah areas in droughty soils (see Figure 3). Mortality has been occurring in these areas for more than a decade. Mortality is continuing, and moisture stressed trees are showing signs of fading, with thinning crowns and chlorotic (yellowish color) conditions in the needles. *Phellinus pini* is common the oak stands, and it is expected that these trees will eventually die or snap-off and create high quality snags. Most larger snags in sugar pine or serpentine pine stands are 5 needle pines that died, likely in part due to white pine blister rust. These resinous snags are often long standing.

Table 24. Snag data averages from stand exams

Stand Type	Average Stand Age	Minimum of Snags (all size classes)	Max of Snags per acre (10-19")	Max of Snags per acre (20"+)	Average of Snags per acre (10-19")	Average of Snags per acre (20"+)
Oak	98	0	29	6	4	1
Serpentine pine	104	0	0	3	0	1
Sugar pine	68	0	20	5	7	3
Max or Averages	**90**	**0**	**29**	**6**	**4**	**1**

It is important to consider the historic dead wood conditions when these stands were being maintained with frequent fire. The oaks stands were maintained with frequent fire, preventing conifers from reaching high densities and also consuming dead wood that may have been created in previous burns. Fire returning regularly in early successional and younger forest stand conditions can lead to dead wood legacies were typically much lower and composed of smaller pieces (Corn and others 1988) (Spies and Franklin 1989) (Nonaka and others 2007). These vegetation communities with frequent fire persisted in lower stand densities and less overall downed wood. This context must be considered when considering management strategies and effects to downed wood and snags within this particular ecosystem. Snags and downed wood can be created and alternatively consumed by fire processes. Down wood also occupies the ground cover and could potentially provide microsites and nutrients that allow facilitate conifer regeneration and conversion of these grassland/savannah soils to forest soils. Tradeoffs of managing for high loads of downed wood and snags in forest types that did not historically support these attributes is considered against other attributes that will result in effective of restoration of these forest types.

Sampled stands and snag densities were modeled over a 100 year period to compare the effects of the density management treatments on long term recruitment of snags. This modeling compared no action, cutting trees 0-28" DBH (Alternative 1), and cutting trees 0-20" DBH (Alternative 3). Treatments in the oak stands would have a long term effect on snag density in treatment areas due to larger reductions in stand density and fewer Douglas-fir trees per acre. This has two effects: there are fewer Douglas-fir to become snags, and competition based mortality will be minimal until stand density reaches approximately 55 relative density. In 2057, FVS projects that the alternative 1 would have 1 snags > 20" DBH, alternative 3 would have 2 snags > 20" DBH, and no action would result in 6 snags >20" DBH. Figure 28 displays this trend continuing to the end of the projection. When looking at the >20" snag data from DecAID, it would contribute towards continued small deficits in the >2 large snags per acre landscape percentages. However, reference conditions modeled under FVS may be misleading to apply to oak savannah and woodlands stands, which would be expected to have lower decadence numbers.

Figure 28. Oak stands - FVS modeled snag densities in 3 prescription alternatives

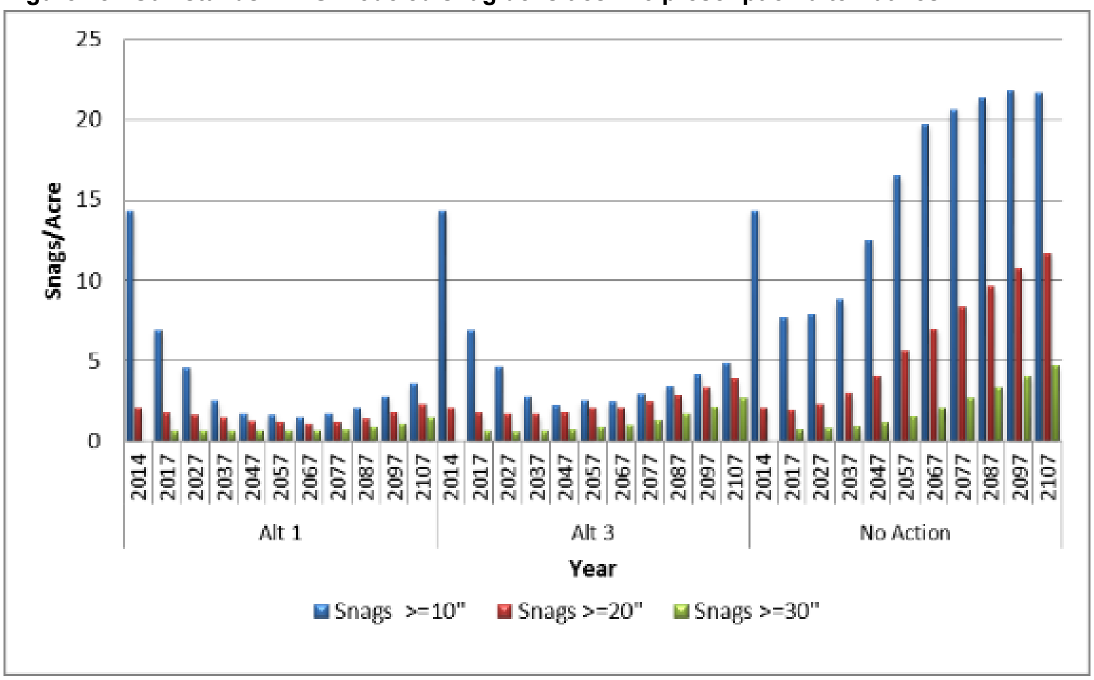


Chart displays snag density (snags/acre) from FVS modeling, for 3 different alternatives over the projection period (90 years). This displays snags/acre for treated areas, not including skips.

In oak restoration treatments, a maximum of 2000 acres would be affected by these treatments thereby it would affect potential areas for dead wood by about 3% in Shasta Costa and 1.7% in Lawson Creek watersheds. Within these watersheds, 97% of lands are in federal ownership with the vast majority of the areas being designated as reserves, and 39-53% of watersheds are in a late-seral condition. Given this context, reducing dead wood recruitment on a contributing percentage of watersheds a spatial area of 3% and 1.7% to restore important habitat types and species diversity is an acceptable tradeoff. Prescription considerations (below) for snags and down wood would also help reduce the effect of treatments on dead wood.

The 100-year DecAID modeling results for the sugar pine projects are very similar to the serpentine pine simulations. Smaller size of trees and retention of a higher number of leave trees per acre results in smaller differences in large snag (>20") creation over time. Snag densities are about 50% lower in treated stands until about 2077 when snag levels increase to levels that are close to the no action.

The serpentine and sugar pine restoration treatments, a maximum of 1100 acres would be affected by these treatments. Thereby it would affect potential areas for dead wood by a spatial extent of about 2.4% in Shasta Costa watershed. Within this watershed, 97% of lands are in federal ownership with the vast majority of the areas being designated as reserves, and 53% of watershed is in a late-seral condition. Given this context, some reduction of the dead wood contributions from a spatial extent of 2.4% percentage of watershed to restore this important forest type is an acceptable tradeoff. Prescription considerations (below) for snags and down wood would also help reduce the effect of treatments on dead wood.

Figure 29. Serpentine pine stands - FVS modeled snag density in Rx alternatives

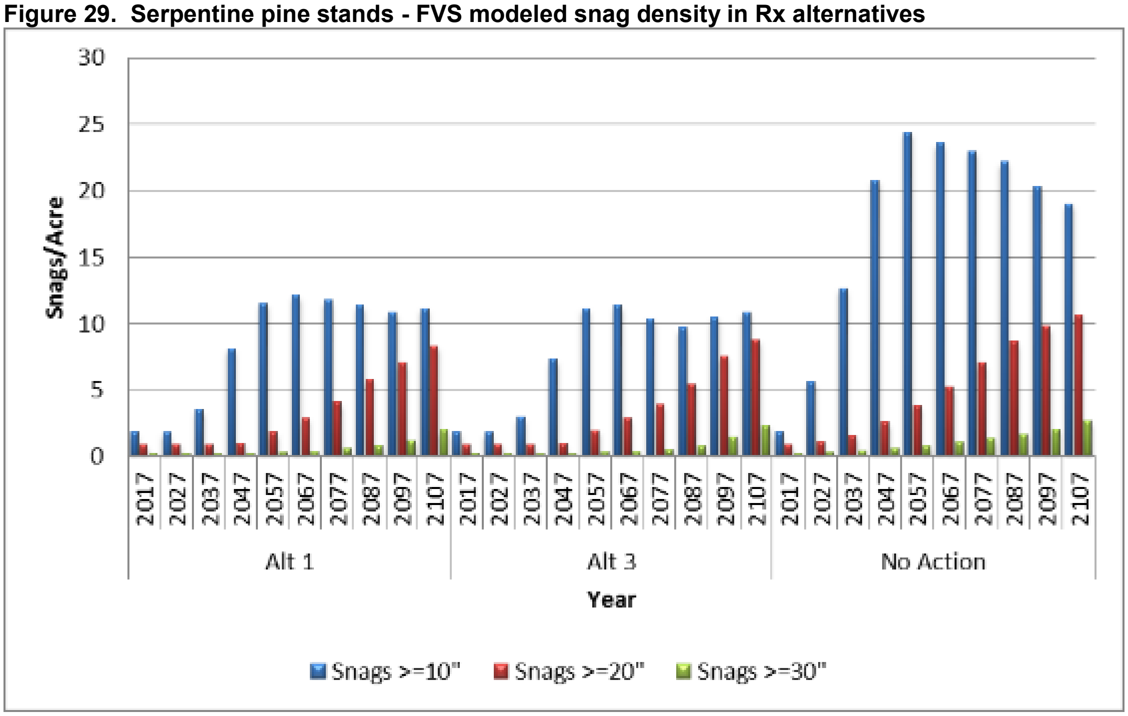


Chart displays snag density (snags/acre) from FVS modeling, for 3 different alternatives over the projection period (90 years).

Figure 30. Sugar pine stands - FVS modeled snag densities in 3 Rx alternatives

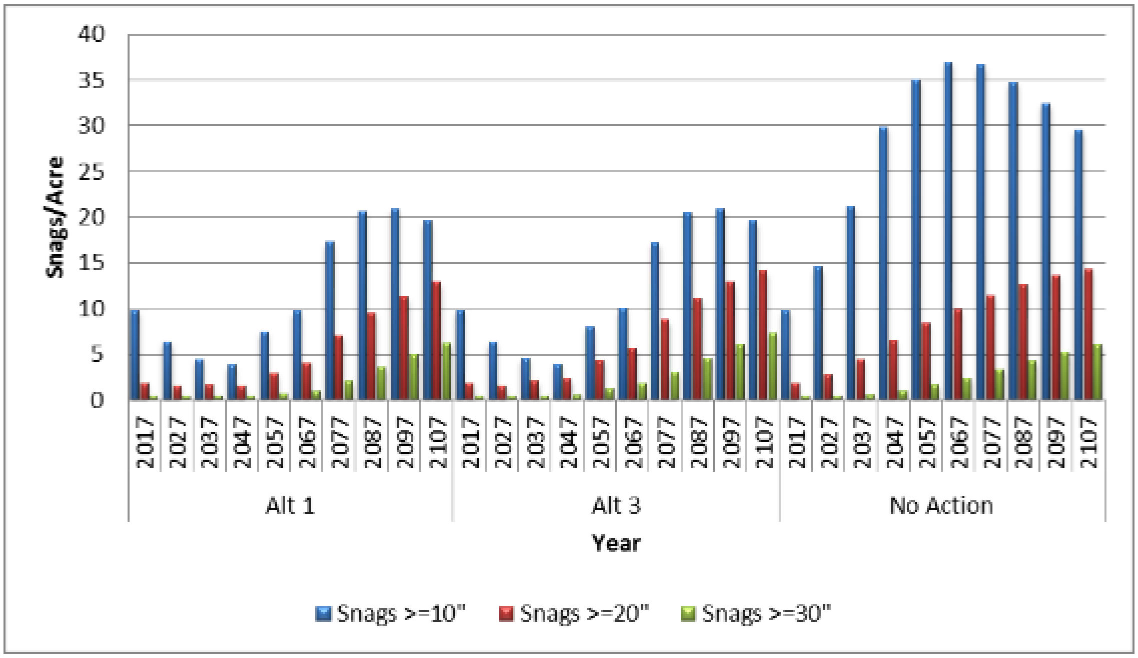


Chart displays snag density (snags/acre) from FVS modeling, for 3 different alternatives over the projection period (90 years).

Prescriptions and dead wood considerations

The prescription would incorporate strategies to protect and recruit dead wood. Achieving the desired density reduction to achieve objectives will result in reductions of down wood over the long run, but they must be considered in scale and context. For example, the proposed action would result in less dead wood in treatment stands over time, but species diversity, large trees, and landscape heterogeneity would be improved. While dead wood would be lower in treatments stands relative to no-action conditions, the landscape is above reference conditions in most size categories for down wood. Snags are deficit across the landscape, and mitigation for this can be addressed in the prescription. The proposed mechanical treatments would retain any existing snags and down woody debris, but the prescribed fire may create new snags while also reducing some existing dead wood. Site specific prescriptions will focus on maintaining and creating snags in riparian areas, skip patches, and interior unit areas away from roads and potential holding lines for prescribed fires.

Prescription considerations for snags and dead wood:

- Existing dead wood; standing and down - Avoid and protect existing snags and down wood ≥12 inches dbh to the greatest extent possible. Use treatment skips to avoid damage or their removal. Retain on-site all existing down wood.
- Locate skips where mature forest structures exist, within riparian areas, and where higher concentrations of snags and down wood are present.
- When applying release treatments around white and black oak, Douglas-fir that would damage, or necessitate felling oaks would not be removed. These trees would be topped or girdled and left.
- Douglas-fir with *Phellinus pini* will remain in stands if it is not a danger tree along open roads.

- Leave adequate number of trees in density management treatments (see Ecology plot data by plant series, Table 25 and Table 26), to ensure recruitment of snags and down wood. Use the criteria above for prioritizing where these dead wood would be located.
- Monitor tree mortality following prescribed fire treatments and create snags as needed following treatments. Ecology plot data would be used to determine quantities of dead wood by plant series. These values would range from 2-5 large snags per acre and 0-200 linear feet per acre for large down wood. See Tables Table 25 & Table 26 for values from Ecology plots.

The Rogue River – Siskiyou N.F. uses ecology-plot data from unmanaged forests to help quantify natural levels of snags and down wood for each plant series and plant association group. The snags and down wood recommendations at final harvest are summarized by plant series in Table 25 and Table 26. These tables display the minimum, maximum, and mean lengths found in the ecology plots within each plant series. It is important to recognize that this ecology-plot data comes from a small number of plots and some of the data is highly variable with wide standard deviations from the mean.

Table 25. Down wood data from ecology plots

Plant Series	Diameter Class	# Plots	MIN length (ft)/ acre	MAX length (ft)/ acre	MEAN length (ft)/ acre	Standard Deviation length (ft)/ acre
Douglas-fir	1-10.9	7	0	1303	931	438
Douglas-fir	11-19.9	7	0	652	186	256
Douglas-fir	20+	7	0	977	140	369
Jeffrey pine	1-10.9	23	326	1303	963	208
Jeffrey pine	11-19.9	23	0	652	57	160
Jeffrey pine	20+	23	0	326	14	68
Tanoak	1-10.9	90	0	3258	997	485
Tanoak	11-19.9	90	0	2607	295	429
Tanoak	20+	90	0	977	143	242
White-fir	1-10.9	231	0	5865	1253	845
White-fir	11-19.9	231	0	2932	370	493
White-fir	20+	231	0	2932	213	377

Data is from Ecology plots, located in unmanaged stands throughout Southwest Oregon.

Table 26. Snag data from ecology plots

Plant Series	Diameter Class	# Plots	MIN TPA	MAX TPA	MEAN TPA	Standard Deviation TPA
Douglas-fir	1-10.9	14	0	255	40	65
Douglas-fir	11-19.9	14	0	37	7	11
Douglas-fir	20+	14	0	21	2	5
Jeffrey pine	1-10.9	28	0	64	8	16
Jeffrey pine	11-19.9	28	0	40	4	8

Plant Series	Diameter Class	# Plots	MIN TPA	MAX TPA	MEAN TPA	Standard Deviation TPA
Jeffrey pine	20+	28	0	8	1	2
Tanoak	1-10.9	105	0	2207	52	225
Tanoak	11-19.9	105	0	20	3	5
Tanoak	20+	105	0	14	2	3
White-fir	1-10.9	259	0	1624	42	125
White-fir	11-19.9	259	0	37	7	9
White-fir	20+	259	0	27	5	5

Data is from Ecology plots, located in unmanaged stands throughout Southwest Oregon.

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